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NOTE. — The Bureau assumes no responsibility with regard to the opinions and the results of experiments outlined in this *Review*.

The Editor's notes are marked (*Ed.*); the letter *R.* indicates the references to the foregoing issues (Monthly and Quarterly) of the International Review.

ORIGINAL ARTICLES

ON THE QUESTION OF THE STANDARDISATION OF WOOL IN THE PREPARATION OF INTERNATIONAL WOOL STATISTICS.

Following up a suggestion on the part of the Government of the United States of America, the International Institute of Agriculture at Rome has drawn up a memorandum, the object of which is the preparation of new and complete statistics regarding wools, the production and consumption, commerce and stocks, of the countries which are principally concerned as producers and consumers. This memorandum was sent to the Ministries, statistical offices, and a few associations and societies interested in wool. By this it is hoped to receive suggestions corresponding to the actual position of the countries and institutions concerned with respect to the preparation of wool statistics.

On page 4 of this memorandum the following remarks are made with regard to wool production: « In some important wool producing countries, for example in the United States of America, Australia, New Zealand and the Union of South Africa, production statistics are already published. It must, however, be observed that even where statistics of wool production exist, the information in general does not quite correspond with the facts. Further, from the point of view of the right time of publication, considerable delay often occurs, so that the figures are more of historic interest than of practical value for joint observation. Detailed description is mostly altogether lacking, or is seldom applied to the important differences between washed and unwashed wool, or to the type of the wool. It can therefore be said that (1) on the part of the governments of important producing countries, exact and exhaustive annual production statistics

must be prepared, and published without any delay ; (2) before the publication of these statistics, estimates must be made just as they are for products of the soil, and these must be published at the time when sheepshearing begins or is in course of operation, in order to supply the markets with trustworthy information ; (3) these advance estimates and statistics should contain all details as to the quantities of wool in the yolk, washed wool and other kinds, such as wool in the fleece, which is contained in the total amount given ; and in such a way that for every category a corresponding weight equivalent in washed wool is given, through which a unitary final sum is arrived at, which can be used for comparison ; (4) these advance estimates and statistics must at least give data as to the different kinds of wool. Until a unitary classification has been arrived at in this matter, a distinction between merino wools and cross-bred wools must suffice on the one hand, and between fine wools (comb or garment wools) and coarse wools (for carpets, mattresses, covers) on the other.

At point 4 of these observations, I may now be permitted to insert my contentions, and I consider it extremely desirable that if once such an extensive work is undertaken as the exact establishment of wool statistics for all the world, a classification as exact and uniform as possible should be used.

How has the classification of wool been carried out hitherto ? On the one hand, one can point to the methods of wool examination as they have existed up to now, or do exist in practice or agriculture, and also as carried out in the wool-working industry, which largely consist of valuation by touch *with the hand*, and *by sight*, with the occasional assistance of *comparison with standard marks*. On the other hand may be mentioned the methods of wool examination which are used in carrying out *scientific examinations of wool* in the various University institutes, where it is mostly a question of establishing, *with the aid of the microscope, the fineness of the individual woollen fibres* in section or in general, the results of which examinations are afterwards made use of, in accordance with defined agreement, for making assortments. In order to give only a short example to show how the judging of the wool can be proceeded with so that sufficiently accurate results may be obtained for scientific investigation, I will now refer to the method of judging the body, fleece and wool of the sheep, which was, and is still in use for definite purposes in the Institute for Animal Breeding and Breeding Biology of the Technischen Hochschule of Munich.

The methods of the Institute for Animal Breeding and Breeding Biology of the Technischen Hochschule of Munich are founded principally on experiments made in Halle, like those in the Institut für Meteorologie und Pflanzenbau (Leiter Professor Dr. P. HOLDERFLEISS (Güldenpfennig) and in the Institut für Tierzucht und Molkerei (formerly Leiter Professor Dr. S. v. NATHUSIUS, now Professor Dr. FRÖLICH) — taking as a basis the excellent, old, practical methods of JULIUS KÜHN, BOHM and others, these latter throughout being the starting point of the new methods of examination of body, fleece and wool of the sheep.

A. — *Judging the sheep.*

(*a*) Breeding value.

The breeding value is determined with breeding charts at hand, with division into breeding classes (Roman figures) and determination of the general breeding value (coloured signs) (1).

(*b*) Body.

Judging the sheep takes place, after selecting a suitable standard, first by looking at it, then taking weights and measurements, by use of points and rectangular processes, using the most common abbreviations, by photography, etc.

B. — *Judging the fleece and the wool.*

(*a*) Fleece.

The fleece, the amount of wool and the wool respectively are judged according to a definite key. The following data are established consecutively :

(1) Degree of fineness and nature of pollution.

(2a) External quality of fleece (close, apparently close, open, wavy, impurity content).

(2b) Internal quality of fleece (even, falling, off, cut).

(3) Staple of the whole fleece (free and easily divided staple, staple difficult to divide, false binder, overgrowth, sedimented or felted near the skin, equally divided or equally formed, unequally divided, even texture, uneven texture.

(1) See HENSELER. Vererbungslehre und Zuchtbuchfuhrung. Verlag HOSANG. Hannover, 1920.

(4) Staple (height and length, tension of the wool, metal elasticity (feeling), diameter and closeness, form of body of the staple, needle fleece, wax points, etc.; internal construction of curliness in the staple: normal flat, smooth or highly curved, state of the staple: erect, oblique, hanging, open, wavy, surface of the staple, differentiation of various stages from short to long).

(5*a*) Strength of the wool coating (distribution over the body).

(5*b*) Wool coating on the belly.

(5*c*) Wool coating on the legs: (bare, to the hock, thick covering of wool).

(5*d*) Wool on the head.

(6) Hair on the face (merino-like, bristly hair, etc.).

(7) Pigment spots (some black or brown spots, fairly bright).

(*b*) Wool Fibre.

(8.) Classification of highest importance fineness, strength of fibre by parting the staple with the hand. In determining this according to sight and touch, points 9 to 16 must be taken into consideration apart from fineness.

(9) Yield (curliness: smooth, flat-curved, clear, highly curved, glassy), determined by blowing the staple apart (also 10).

(10) Character: (inclined to be too coarse, coarse, very coarse, i. e. harsh).

(11) Truth: (uniformity).

(12) Thread formation: (belly, belly and flank, whole fleece).

(13) Height and length of fibre.

(14) Colour of the fibre.

(15) Glossiness: silky dull, lustrons.

(16) Perspiration: (inclination to heavy perspiration, moderate perspiration, very loaded, yellow perspiration, wax perspiration).

(*c*) Skin and horns.

(17) Wrinkle formation: Free from wrinkles, indicated wrinkled.

(18) Ear: form, carriage, fineness.

(19) Other formations appearing on the skin.

(20) Horns: strength, form, position, colour.

(21) Finally, the weight of the fleece is determined immediately after shearing, and in air-dried condition. Points 1-16 are also decisive for judging the evenness of the fleece.

For further exact examination, samples of wool are taken from about seven parts of the body, namely, the *blade* (shoulder), the *flank* (last true rib), the middle of the curve of the loins, the withers, the nape of the neck, the *middle of the hind leg*, and the middle of the belly. The parts in italics are the most important.

For scientific purposes, the number of parts of the body to be examined (as a rule more than seven) is arranged according to the object of the investigation.

Manner of taking:

The samples, as far as possible of fully 2.5 cm. diameter, are cut off close to the skin, without pulling, so that they will keep the natural form as far as possible.

For exact judging, the wool, or say individual samples of wool and wool fibres are then subjected, one after the other, to the following examinations:

(1) Working up the wool fibres to a dry substance:

2.5 grammes of wool are kept for 2 hours in the drying cupboard at 98° C., and then cooled in the desiccator. This treatment is continued until constant weight is arrived at. The dry substance is then given in % of the raw wool.

(2) Determining the washing:

2-3 gr. of wool, by means of a glass rod in a porcelain vessel, are washed with ordinary water of room temperature until the washing liquid remains clear, then dried in the drying cupboard at about 100° C., and cooled in the desiccator to constant weight. The residue is then given in % of the raw wool.

(3) Working up the wool for yield:

(*a*) with 5 % soda solution: 2-3 gr. raw wool are first of all washed in the water bath in clean tap water, and then in 5 % soda solution, in which to one part by weight of wool there are about 40-50 parts by weight of solution. The washing in soda solution continues, with one change of solution, for one hour. It is afterwards washed with distilled warm water, until there is no longer any cloudiness in the washing liquid. The temperature of the washing liquid is kept at 50-55° C. by the water bath.

After washing, it is dried at about 100° C. and then cooled in the desiccator. This is continued until constant weight is attained.

(*b*) with ether:

The last residue of fat is drawn out by ether extraction, determined in accordance with the usual Soxhlet method. (These

quantities of fat, however, are so small — scarcely weighable — that this process can hardly be taken into account in practice).

The yield is multiplied by 1.17 (corresponding to normal moisture contents of 17 % water) and expressed in % of raw wool.

(4) Determination of the glow residue: 2-3 gr. of wool, combined with 5 % soda solution, are reduced to ashes in the platinum crucible, the residue being given in % of initial weight.

(5) Elastic reaction with chlorine water (*Allwörthen* reaction).

(6) Determination of curliness: Wool from which the fat has not been removed is smoothed with the curling knife (BLOCK and HARTMANN wool knives are available) and then the division is made into the individual grades of fineness (assortments).

(7) Determination of fineness: The determination of the fineness is made by the microscope, magnifying 1000-fold, with a micrometer value of 2.4;

(*a*) in survey (mostly for practical purposes).
(*b*) in cross section (for scientific investigations),
(*c*) With the aid of specific weight.

The cleaning of the wool fibres, which are microscopically examined, is done very carefully with ether or also with Carbonic Disulphide or Carbon tetrachloride.

As regards (*a*) determination in survey: Samples of 100 wool fibres each are obtained for examination. Glycerine free from water is used as bedding material. Should the uniform structure of the wool have to be specially investigated, then the diameter of the fibre is measured at as many places as possible; otherwise, each of the wool fibres in the lock is measured in three places, namely, at the base, the middle and the point, special care being taken that the measuring place and onwards is to a great extent of fairly similar nature.

Elaboration of the counting material: From the counting material obtained for normal use especially the arithmetical average is usually determined. Under special circumstances, however, particularly in scientific investigations, the average deviation from mean value, or the standard deviation, is also calculated. Finally, the maximum and minimum counts are given, and their differences, and generally speaking all biometrical methods are used as necessary.

As regards (*b*) In cross section: The wool fibre is bedded in unheated paraffin of a melting point of 60-65° C., and cut with the microtome. The cutting is examined, in glycerine free from water,

under the microscope. The number of the fibres examined is 100; as above with (*a*). Optionally, either many fibres, at least 100, are examined, taking one cross section from each, or (*b*) several cross sections are taken from each of a smaller number of fibres.

Elaboration of the counting material in these cross section examinations: Calculation of the arithmetical average, otherwise as above.

In scientific investigations the geometrical mean is also used, for comparison and to prove the method.

(8) Determination of physical qualities:

For investigating the physical qualities, in addition to the old apparatus of *Menzel*, *Bohm*, *Güldenpfennig* amongst others, the «Deforden» apparatus from Krais-Dresden is used in accordance with instructions. Amongst other things are determined: Durability, carrying power, elasticity, torsion capacity, with which recently time exposure photographs have been used as an assistance.

(Permanent preparations are bedded in xylol, as glycerine in time absorbs water).

It must, however, be further mentioned here that most of the other animal breeding institutes of Germany (and of course other countries also), e. g. the Universities of *Halle*, *Leipzig*, *Göttingen* and *Breslau*, the Agricultural High School of *Berlin*, the Veterinary High School of *Hanover*, possess regulations and instructions for the valuation of wool, which in thoroughness and originality leave nothing to be desired. It is obvious, however, that the methods used for scientific purposes are utilized slightly or not at all in the way of being introduced into the broad practice of the breeding world, or in producing necessary results in a short time in trade and industry. Still, as mentioned at the beginning, valuation has been introduced into the practice of agriculture, trade and industry, principally by touch and sight, and occasionally with the aid of standard marks. But this valuation by touch and sight, as at present carried out, cannot be satisfactory, and cannot be taken as a standard, for a general valid classification of wool, such as appears to be necessary for the preparation of wool statistics by the International Agricultural Institute of Rome. This valuation by touch and sight is individual, and must vary in each case according to the views and capability of the judge. It cannot be doubted that there are certain men with a special gift, who really can give a serviceable valuation bye touch and sight, whose classification of wool can and must be taken as standard for definite commercial and manufacturing purposes

But beyond these, there is an army of breeders and other experts, to whom the valuation of wool means a question of livelihood and who can and must demand that an objective valuation be carried out, which all can understand and make use of without further trouble.

In order to discover such a method, there has been carried out in the last few years, in the Institut für Tierzucht und Züchtungsbiologie der Technischen Hochschule München, at my suggestion, and under my guidance, extensive work which leads to the conclusion that an apparatus has now really been constructed which makes possible this long desired objective wool classification, so far as is technically practicable, and in such a way that its introduction and operation in agricultural practice, also sheep breeding, in trade, and also in the wool-working industry, can present no difficulty. It is above all owing to the service rendered by Diplomlandwirts Dr. HERBERT DOEHNER of Chemnitz, in constructing a special form of Trichinoscope, that this method is capable of being realised in practice. Details of the method are to be found in the treatise entitled: « *Eine neue Methode zur Feinheitsbestimmung von Haaren und ihre praktische Auswirkung zur Sortimentsbestimmung von Schafherden, anwendbar auch auf die Bestillung der Feinheit von Textilfasern* ». (A new method for determining the fineness of wool fibres, and its practical working in determing the sorting of flocks of sheep, also applicable to the determination of the fineness of textile threads). The work was registered at the end of 1925 by the Technischen Hochschule München as *doctoral* work, and is already in print.

The substance of this Munich method is only briefly described here, and attention drawn to its special advantages. For the sake of simplicity I confine myself partly, in the following deductions, to passages from the Doehner work.

The following is said on the *description of the apparatus* and its *origin*: « It is obvious that, on account of the natural smallness of the object (wool fibres) one cannot work with the naked eye in measuring, but must use enlargements unconditionally. For the foregoing practical aim a microscope is not of much account, as it requires a certain amount of training. If, therefore, a new workable method is to be created, then to begin with it must be realized that in practice there can only be used a process which is not only free from science, but must be so formed technically that it can be carried out by anybody, even the unskilled. It is of course natural that if a matter with such requirements is taken in hand, there must from the beginn-

ing be certain limitations. In this it is absolutely correct to differentiate between a process the object of which is to determine the *assortment of great masses of wool*, or to carry out the *classification of great masses of wool*, that being the problem which it was sought to solve, and *scientific examination of individual fibres* with the object of studying histological or other circumstances in connection with the fibre. The latter requires very much greater exactitude, a complicated optical system, and consequently, of course, greater magnification. All these, however, are accompaniments which cannot be worked with on account of high cost, or insufficient training of the person making the examination. It must also be borne in mind that even in the case of the skilled worker, it is easily understood that the making of a great number of microscopic measurements in time becomes an impossibility, because, amongst other things, the eyes become so tired that the exactness of the measurements suffers considerably thereby. Recently special attention has been paid to this on various sides, and it has also been sought to remove this evil by making measurements on projected pictures (1).

There remained, therefore, nothing else to do but to look round for another *new* apparatus which would enable the object to be attained. On the occasion of inspections of the Slaughter-house and Cattle Yard of Munich, *trichinoscopes* were introduced, whose build and construction appeared specially suitable for being applied to examinations of wool. The method of working with the trichinoscope is, very simply, as follows. The meat to be examined is pressed between two glass plates, and thereby the difficult cutting of the skin is avoided. The projected picture of the prepared substance then permits a wide field of survey, in which the trichinae can be sought without force. If, instead of the meat preparation, a wool preparation is put in the light-cone, then the picture of the wool appears on the screen as a great field for survey, and gives the possibility of exact measurements at hundreds of places.

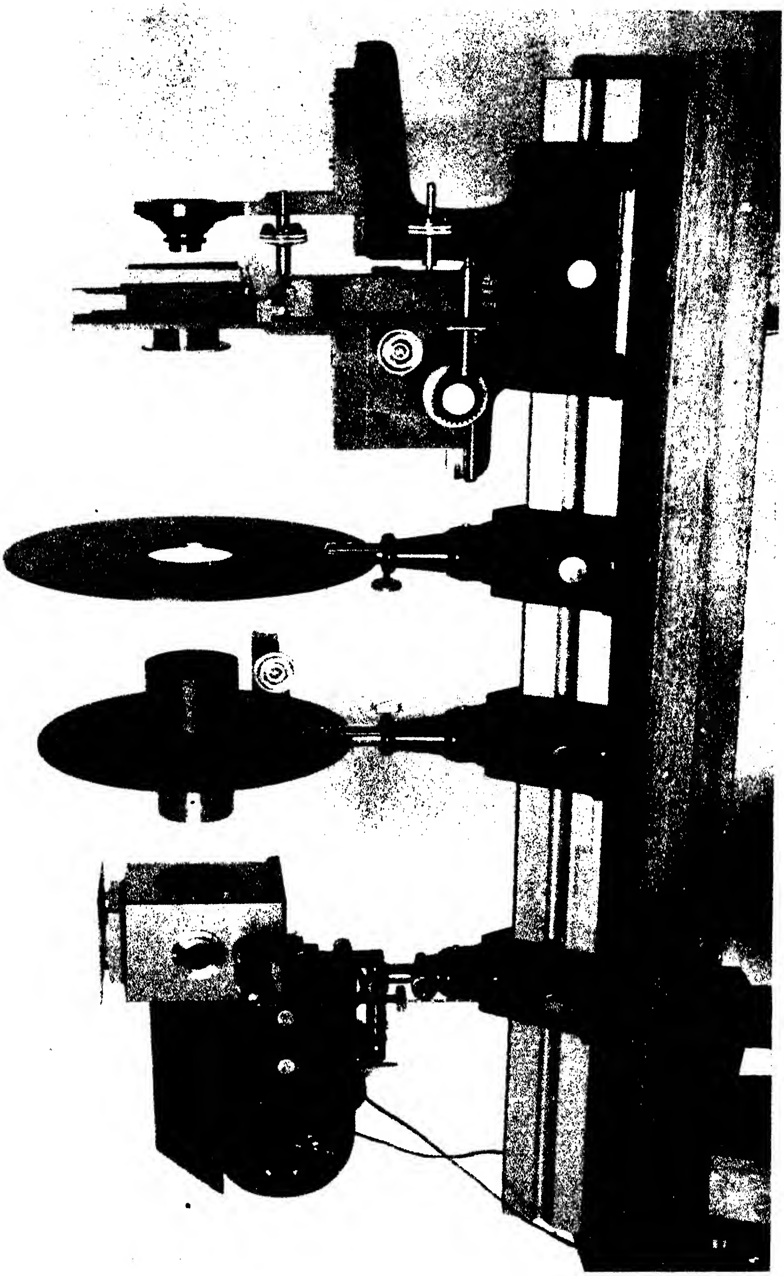
The apparatus constructed by the firm of LEITZ, of Wetzlar, in accordance with the proposal of Dr. DOEHNER, is composed as follows, and as can also be seen from the accompanying illustrations 65, 66, 67.

As the source of light an arc lamp is used, with light-tight frame and special collimator, of a strength of 8 amperes. It can be attached)

(1) C. NAUMANN. Die Bestimmung des Feinheitsgrades von Wollhaaren nach Messen an ihren Projectionsbildern. *Zeitschrift f. Tierzucht u. Zücht. Biol.*, Bd. 3, Heft 1. Verlag P. Parey, Berlin.

with the corresponding resistance, at *every* lighting circuit. By means of a clockwork regulator the lamp burns evenly for hours together, without it being necessary to regulate the carbon. This regulation must be certain of fulfilment, for, as will be pointed out later, the measuring work is carried out at a distance of several metres from the apparatus, so that attending to the same would always mean an interruption of the work. In front of the arc lamp there is a screen which prevents any light escaping at the sides, so that the remaining space keeps perfectly dark, and consequently the projected picture appears clearcut on the wall. The crossbeam situated farthest forward carries a large cross-table, which permits of both a horizontal and a vertical movement, so that the preparation received on this cross-table can be observed in its full extent. For receiving the object there is a specially constructed « Cüvette ». This consists of a glass cistern with three divisions. The three divisions make it possible to prepare samples of the side, shoulder and leg of a beast for measurement at the same time. Each division is furnished with guides for receiving two glass plates, between which is the wool for examination. The « Cüvette » is made entirely of crystal glass, and allows the light falling parallel to pass out again. The optics of the apparatus, placed immediately in front of the preparation, consist of a microsummar of 24 mm. focal distance for small enlargements, or for greater enlargements there can be inserted objective 3 etc., in the same thread, as with the microscope. For great enlargements there is a special wooden frame for receiving the object-carrier for wool preparation and cover-glasses. The microscope objectives above number 3 are very long in their construction, so that it is no longer possible, on account of the thick glass wall of the Cüvette, to get near enough to the object. The result of this is a picture which is not sharp. With the frame arrangement, however, as the thick glass wall is done away with, a sharp impression can be obtained without trouble. The projected picture is now obtained by a screen specially constructed for the purpose of measuring. (Illustration 67). In a circular frame there is stretched a parchment paper, which is furnished with millimetre division squares, also millimetre paper. After exhaustive investigation, it appeared that it was best to project the picture through the screen, and then work out the measurements at the back of the picture. One can thus stand directly in front of the picture, and therefore vertically opposite it: If, however, it were desired to measure in front of the screen, one would be in the

PLATE XVI.



Lighting lens. Diaphragm. "Cuvette" table with "Cuvette" "Cuvette" objective

FIG. 65.—Lighting arrangement.

PLATE XVII.

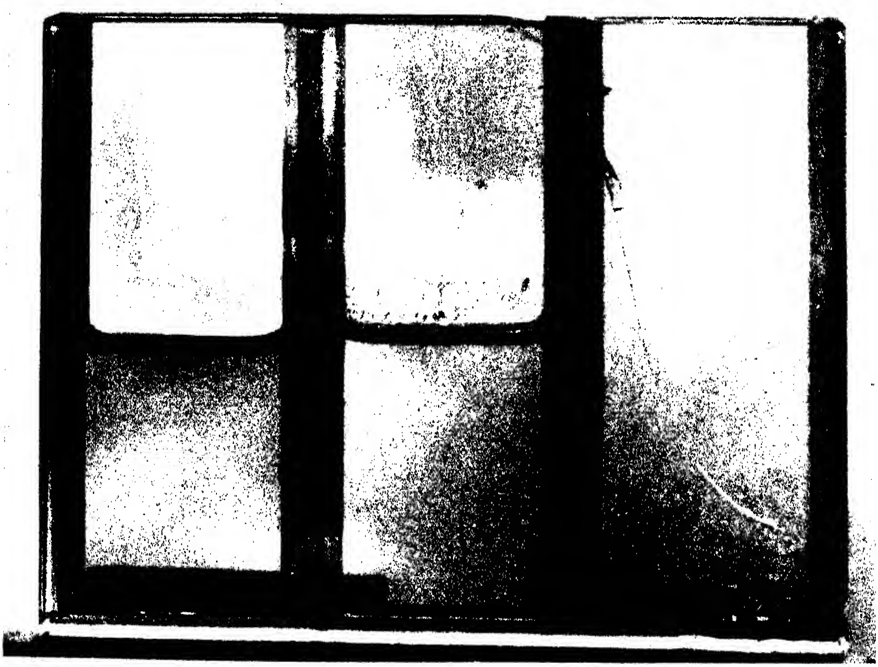
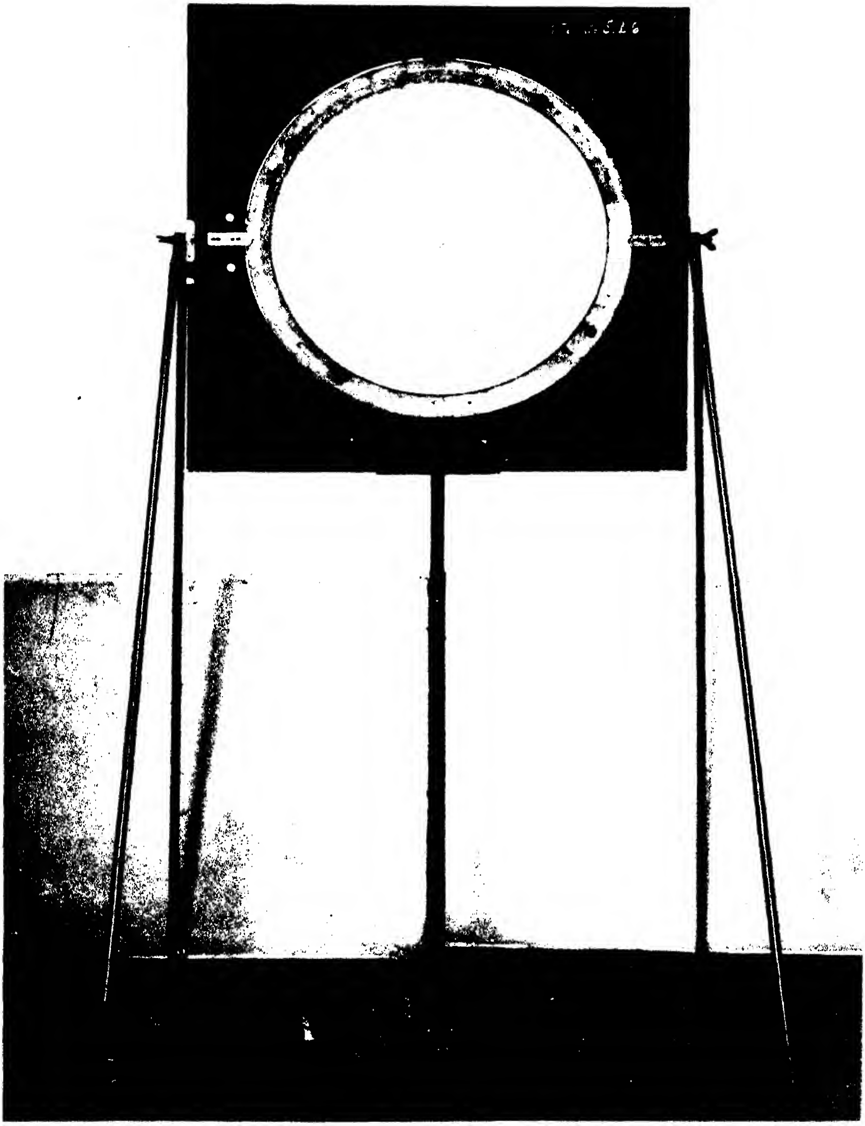


FIG. 66.—"Cuvette" divided into 3 sections corresponding to the 3 samples of wool to be taken from the shoulder, side and leg, filled with thinned cedar oil; the right compartment contains the glass plates between which the strands of wool have to lie. The two other compartments, left and middle, are here on the picture without glass plates, only half filled with cedar oil

Plate XVIII



67.— Screen, revolving in ball bearings, spanned with coordinate paper coated with paraffin, for receiving the projection pictures or the pictures of the standard marks.

light, and to avoid this, only a side view of the picture would be possible, which, however, would lead to inaccurate readings. In order to obtain a clear picture at the back, the parchment paper is coated on both sides with a thin layer of paraffin. The frame with the stretched paper now runs in a revolving guide, so that it is possible to carry out measurements everywhere, that is, at every part of the screen. Technically the measuring is then carried out in such a way that the screen with the division revolves until it is possible for one side of a millimetre square to cover one side of the hair to be measured. It is then easy to read off its thickness by the number of the covering squares. The division strokes can then be calculated easily in micro in accordance with a gauge to be described later. The lie of the hairs in the field of vision is thus a matter of perfect indifference as regards the measurements, because by the revolving system measurement is possible anywhere. This arrangement is preferred to the otherwise usual measuring with a specially arranged ruler, as it is considered simpler, and quicker to operate. The screen is firmly fixed laterally by rods, so that it remains quite still even when the measuring disc is revolving. According to the desired degree of enlargement, the screen must now be placed at a different distance from the apparatus, but always at a greater distance than that at which one could regulate it. It is therefore necessary to have also a check controlled from a distance both for the vertical and horizontal motions of the Cüvette, and for the sharp checking of the object. The ends of this check run into knobs which are fixed on the measuring screen, so that the person engaged there can make use of the apparatus without getting up, i. e. can comfortably work the check.

We must now describe the technique of large scale examination by the apparatus.

As regards taking samples of wool from the animal itself, the Investigation Committee for Methods of Wool Examination of the German Agricultural Society of Berlin at the Autumn Meeting at Würzburg decided that three samples shoud be taken. The selected samples are cut from the left side of the animal (in case the wool on the left side should be damaged, the samples are taken from the right side).

The samples are taken:

(1) From the shoulder in the middle of the shoulder-blade, high up.

(2) From the middle of the side, at the last true rib.

(3) From the middle of the leg, two fingers away from the socket.

The size of the sample, for microscopic examinations, must be at least 3 cm. in diameter.

Each sample comes in a small paper bag by itself, and this bears an inscription giving the part of the body whence it is taken. All three samples from one animal are stored away in one large paper bag. On this must be given the number of the animal, and anything else which is necessary, according to the purpose of the examination. It is of great importance that the samples of wool should be well prepared for examination in the above manner, as otherwise they might easily be separated from each other later, or be exchanged, and so inaccurate or quite false results obtained. From each sample of wool a little strand is now taken as carefully as possible, so that the texture of the staple is not destroyed. The fat is now removed from this strand by ether, and a wide camel-hair brush is passed over it several times, until the greater part of the dirt is removed. The main thing is that the structure of the strand should not be completely destroyed. It is absolutely necessary that this should be seen in the picture projected later.

The wool prepared in this way is now laid between two glass plates which must be perfectly dry and clean. These must be pushed slowly into the guides of the " Cüvetta " which has been filled with cedar oil, so that the oil can distribute itself evenly everywhere, without one blowing. Such would be the case if the plates were still greasy from previous examinations. It is therefore absolutely necessary that they should be cleaned perfectly after the examination. Sulphuric acid is most suitable for this, and, for the sake of cheapness, the so-called technical acid, which is not yet cleaned. To obtain still better cleaning of the plates, a little bichromate of potassium is added. In practice the cleaning process is very simple. The glass plates are simply thrown into a pot with the sulphuric acid prepared in this way, and the next day they are taken out again with a pair of pincers, washed with water, and dried.

If the three samples from the sheep have now been prepared for measuring in the " Cuvette ", this can be proceeded with. The actual measuring is preceded by an observation of the structure of the staple as a whole, in order to see how it shows the strand in its whole course. For this it is best to take a low enlargement (microsummar 24) and thus get better general views. This can be observed

either on the screen itself, or a sheet of white paper can be put at any point on the path of the light rays, according to the enlargement desired, on which the desired staple structure can be observed.

At this point something further must be said as to why individual fibres are not examined, but the small strand of fibres left complete in its natural combination. As regards preparation for the examination of individual fibres, first of all this wastes a great deal of time, and what is of still greater importance, it carries with it tremendous sources of error. The Hanover process (1) requires that the individual fibres should be stretched out, so that when they are measured in air, they are found stretched straight under the microscope, and can so be measured. This straight stretching of the fibre is now very difficult, however, because in the first place, with a fine fibre it cannot be seen at all accurately with the naked eye whether all curling has disappeared from the fibre. The result of this will be that there will be further drawing out, and consequently the fibre will be involuntarily lengthened and its cross section thus altered. This will occur still more easily if it is required to uncurl the fibre in combination, which is absolutely necessary in measuring the cross section.

If curly lumps are also present, then with the finest bedding-in process it will no longer be possible to get cross sections. The results of this are deep cuts with entirely inaccurate measuring results (2). MANNSFELDT in his work on the uniform structure of the wool fibre in the Würtemberg improved land-sheep, with contributions on the technique of wool examination (3) notes that by drawing the fibre out of curl, the lower end of it is already tensely stretched whilst the upper end is still not uncurled at all.

Further, he makes a practice, as does also DOEHNER, of observing the fibres in combination, remarking that in measuring the individual fibre in its whole length from the point to the base, great fluctuations (8-10 micra) of cross-section occur. This is a proof that it is not possible to determine the assortment accurately by merely, as

(1) C. KRONACHER. Neues über Haare und Wolle. *Zeitschr. f. Tierz. u. Zücht. Biol.*, Bd. 1, Heft. 1, 1924.

(2) KRONACHER SACHSINGEN und SCHÄPER die Wollefeinh. Best. am Querschnitt. Bild. u. i. Projekt. Bild. *Zeitschr. f. Tierz. u. Zücht. Biol.*, Bd. 2, Heft 3, S. 224. August 1925.

(3) MANNSFELDT. Untersuchungen über die Treue des Wollhaares beim Württemberg, veredelten Landschaf m. Beitr. für Techn. der Messung, der Wollfeinheit. *Zeitschrift f. Tierz. u. Zücht. Biol.*, Bd. 4, Heft 1 und 2. June 1925

in the *Halle* process for example, cutting off the lowest millimetre of the fibre and then taking measurement of this piece.

The result of the MANNSFELDT investigations, as laid down on page 160 and following, says: « The wool fibre of the ram is almost of equal thickness throughout its whole length.

With the ewe, however, it is finer towards the base.

The reason is to be found in a regular nourishment of the ram during the whole year, as opposed to an irregular nourishment of the ewe. In comparative examinations of sheep left out grazing, it appeared that an irregular nourishment, such as is caused by roaming the pastures, has a greater influence on the strength of the wool fibres than on gestation and milk secretion ».

The refinement of the fibres towards the base will perhaps not be so much in evidence with the finer and more even wools as was the case with the Mannsfeldt examinations of the Würtemberg improved land-sheep. Still, attention must certainly be paid to this factor in the methods of wool examination. The variation in strength of the wool fibre in its whole course is also plainly to be seen if the projected picture of a little strand, enlarged from top to bottom, is observed. These proportions can only be got correctly if measurements are made of every section of the fibre from point to base. This is most easily possible, however, if one has before one the whole combination of the staple, because in all parts sufficient possibilities of measuring can be found. It can at least be claimed that the measurements so obtained come as near to the actual proportions as is within the reach of possibility. All other methods, such as measuring the smallest cuttings of wool fibres (Halle), or measuring cross sections of them (Hanover) necessitate in order to do justice to these conditions, the taking of samples from different parts in the length of the fibre from top to bottom, or an attempt — which would be different in each breed — in a preliminary examination to find places where all the fibres showed the same length in relation to the cross-section. Of course the latter would take a very great deal of time in carrying out the method technically, and so make the work unprofitable. Moreover, the search for such faultless parts is only a makeshift, and as such should be little used. A further advantage of the use of the whole strand, retaining its complete natural proportions of construction, is that the character of the curling can be at once determined in the picture. The curling locks, in the places where the wool fibres still hang together, will be strongly marked in the picture, and can

easily be judged. One can even go further, and maintain that it is superfluous to take measurements, and for judging a flock it is sufficient to work on the general impression of the structure of the staple, and determine the assortment in accordance therewith. According to the strength of the wool fibre the picture of the strand will sometimes be quite typical, and sometimes not true to type. If now *standard pictures* of each assortment, prepared by a photographic method to be described later, are produced, then it is an easy matter, by comparing the projected picture with the corresponding standard picture, to determine the required assortment. It requires nothing more than a good eye, and after a little practice this method of determining assortments can be carried out even by people who are laymen in wool valuation. The time which this examination requires is then the least possible and amounts to only a few seconds. The general view of the staple, moreover, shows all the diseases and changes which often occur in the wool fibres, and the recognition of which is of such great importance for the wool-using industry. The Munich method also allows one to study the formation of thread marks.

In making observations with these pictures giving a general view, it is far better not to have the enlargement too great. In the Doehner examination it is assumed that fifty to sixty-fold is quite large enough. If the enlargement is carried further, then only a few individual fibres are presented sharply, because the wool, of course, lies quite freely in the "Cüvette" between the two plates, and is only exposed to the adhesive pressure between the two plates, so that the fibres lie in different optical planes. The result of this is that naturally only one plane can be focussed sharply, and obviously a perfectly sharp general view of all the tibres is never obtained. Then the field of vision must certainly be changed, which is necessary without further ceremony. Great enlargement comes into account in measuring in another connection, and its use will be described later.

At the place where otherwise the two glass plates with the sample of wool are pushed into the "Cüvette", an object micrometer (division etched on a object-carrier mm. 1 in 100 parts) is inserted, and this division projected on the screen. By comparing the projected division with that fixed on the screen, the micrometer value is then obtained, which of course is only valid for one and the same enlargement and one and the same distance of the screen from the apparatus.

Example of the calculation:

10 parts of the projected division are covered by 19 parts of the

division of the screen. The calculation of this result then gives a micrometer value of 5.26. The number of the division marks on the individual fibres found by the measurement must therefore in this case always be multiplied by 5.26 in order to get the strength of the fibre in micra. In the above calculation the 10 projected division mark had to be again multiplied by 10, as the division on the object-carrier is only made so that one division mark bears 10 micra. At the micrometer values of the microscopic measurements, there enters therefore the division of the screen, and the object-micrometer is not on the object-table, as with the microscope, but in the « Cüvette » at the position of the object.

As regards the measuring, this, with a little practice, is very easy to carry out. In accordance with the DOEHNER examinations, it is best for the measurement to be done with 183-fold enlargement, therefore with a micrometer value of 5.26 and a distance of the measuring screen from the apparatus of 295 cm. The bedding in cedar oil then ensures that the fibres can be focussed perfectly on the screen, without shadows on the edges, and thereby exact measuring results obtained. This would not be the case if, for example, glycerine were used for bedding in, as then too large black shadows would lie on the edges, and make the measurements inaccurate. The cedar oil is the same as is used for oil immersions, but of a certain thinness. In commerce it is known as « cedar oil for clarifying microscopic preparations ». As already mentioned above, the fibres by being bedded without force in the « Cüvette », are found in different optical planes, so that always only one plane can be sharply focussed. This is then focussed in measuring, and all fibres are measured which are sharply imaged, in order then to focus sharply another plane. In the work some care must be taken that the staple is drawn through the field of vision in its whole course, so that the measurements may extend regularly over the whole course of the staple, and calcutions made of any strengthening or weakening of the hair at any part of it. It is always best to measure from the points of the hairs (i. e. from the uppermost end of the staple) onwards to their ends, so that in comparing the individual measurements you always have before you the same parts of the group.

For the sake of accuracy in the measurements, and with the object of achieving greater speed in the work, it is very useful for one examiner to carry out the measurements, and another to note down the results.

The testing of this new Munich projecting method by comparing it with the measuring methods of other institutes showed the completely satisfactory utility of this method for carrying out measurements. A comparison of the results of the Munich projection method as they were read off the projection scheme, with the results as found direct in the microscope, showed no great difference in the findings, so that in this respect also no objections can be raised to the projection method. Another considerable advantage of the Munich projection method for measuring is that the material for the measurements is given in such a way by projection of the whole staple, that it corresponds to the actual conditions on the body of the animal or in the wool samples of commerce, and cannot be influenced by a voluntary or involuntary selection in taking samples of fibres for the microscopical examination of individual fibres.

It must again be expressly stated here, however, that in the first degree this Munich method has been worked out in order to get as perfect as possible a picture of the wool, in the presence of which a quick, objective carrying out of wool classification, free from objection, is possible in the practice of sheep breeding, commerce, and the wool working industry, and not simply for the purpose of investigating or measuring the fineness of the wool fibre.

In conclusion, I would draw attention to a few special advantages offered by the Münich method or apparatus. Above all, it is absolutely necessary that the sheep breeder should penetrate more into the secrets of the wool. The profit in sheep breeding depends for the greater part, at least in certain directions of breeding, on the production of wool which is as valuable as possible, or which can be well utilized. The structure of the wool fibre or of the fleece of the animal, is also at the same time an external indication of the hereditary qualities lying in the individual. The accurate examination of the wool can therefore give a picture of the breeding standard of the flock; breeding unsuitableness and faults of any kind, false curling, appearances of degeneration, etc., can be immediately recognized in the picture of the wool fibre of the animal concerned. Before all, stress must here be laid on the great importance of seeing that the wool to be produced shall show an undoubted regularity or better uniformity, and on the fact that the picture of the strand or staple produced by the Munich method gives definite information regarding this uniformity. As regards determination of the assortment, it is impossible in practice to carry out direct microscopic measurements

of the fineness of wool fibres in the mass. With the Münich method it is easily possible to obtain pictures giving a general view, which even by themselves, but still better after comparison with standard pictures, put the observer in an excellent position to determine the classification.

Such pictures can easily be made into permanent photographes costing only a few pence. One simply puts a frame with gas-light paper (Leonar extra hard, for example, does very well) in the light-cone of the apparatus, lights up for a few minutes, develops, and then has a perfect photograph, true to nature, of the wool concerned. If, therefore, examinations of wool are carried out at any institute for the advancement of breeding, it is easy to forward to the sender of the wool sample a picture from which he can obtain much valuable information for his breeding. In the appendix to the DOEHNER work, pictures of such photographs are reproduced, which are also given here at the conclusion of my observations. They are illustrations of wool, from the finest merino to the coarsest land-sheep, from the collection of wool of the Institute for Animal Breeding and Breeding Biology of the Technical High School of Munich, which to some extent have served, or may serve as standard pictures.

Photographs are also taken of wool and cotton yarns, therefore of manufactured wool, and it is seen that in spite of the thickness of the object, very good pictures can be obtained. Of course, the photographs must always be taken at the same distance, and with the same objective, otherwise they cannot be compared with each other. The pictures published in the DOEHNER work were made at a distance of 109 cm. of the picture from the apparatus, a 43-fold enlargement, with the microsummar 24 mm. focal distance. (The illustrations were then, in the printing, reduced to $^3/_4$ of their natural size). If a glass plate, with etched millimetre division, is laid on the photograph, then with this there is quite a good standard of comparison for the thickness of the individual fibres. The pictures also show the course of the curling, so that direct curling studies can also be made. If such general views are now prepared of fibres of every assortment class, which have previously been measured accurately to show to which assortment or quality class they belong, then standard pictures of assortment or quality are obtained in a comparatively easy manner, as has been repeatedly mentioned before. Certainly, the projected pictures of the samples of wool which are to be examined, when compared with these standard pictures, do not always represent pure as-

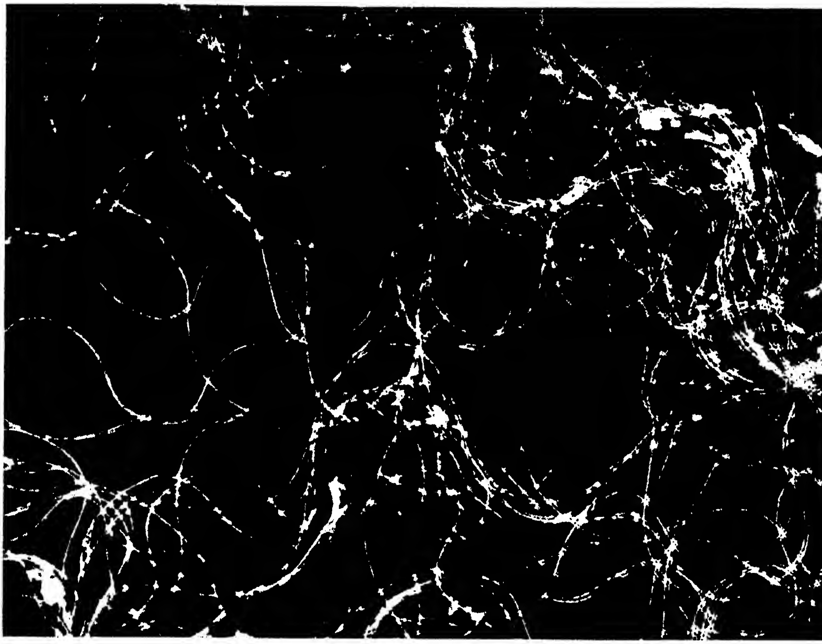


Fig. 69.—Negretti.

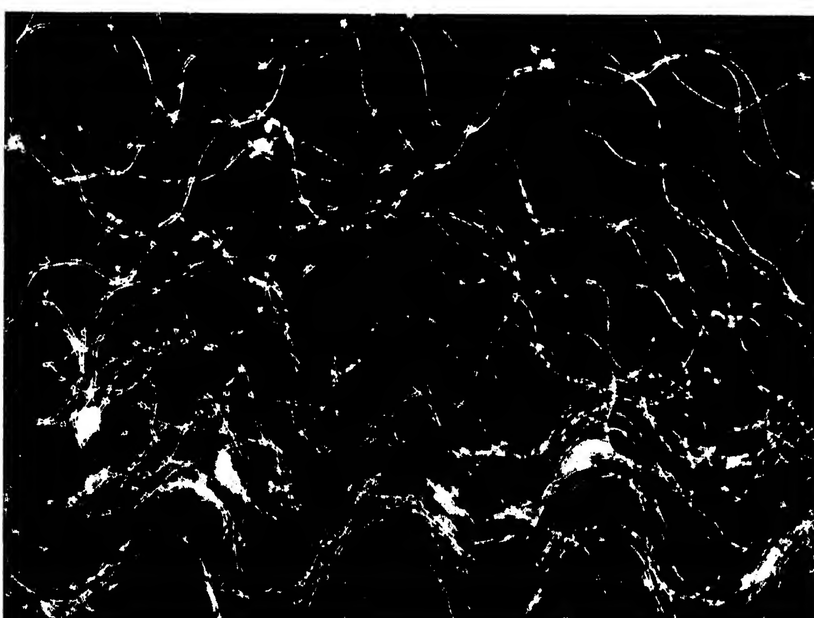


FIG. 68.—Merino Electoral.

PLATE XX.

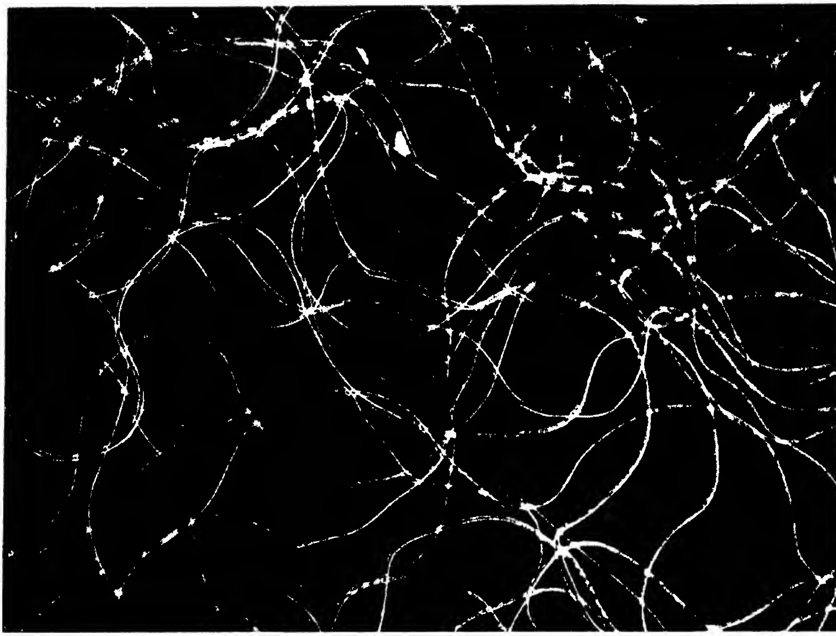


FIG. [illegible] — German merit-wool sheep.

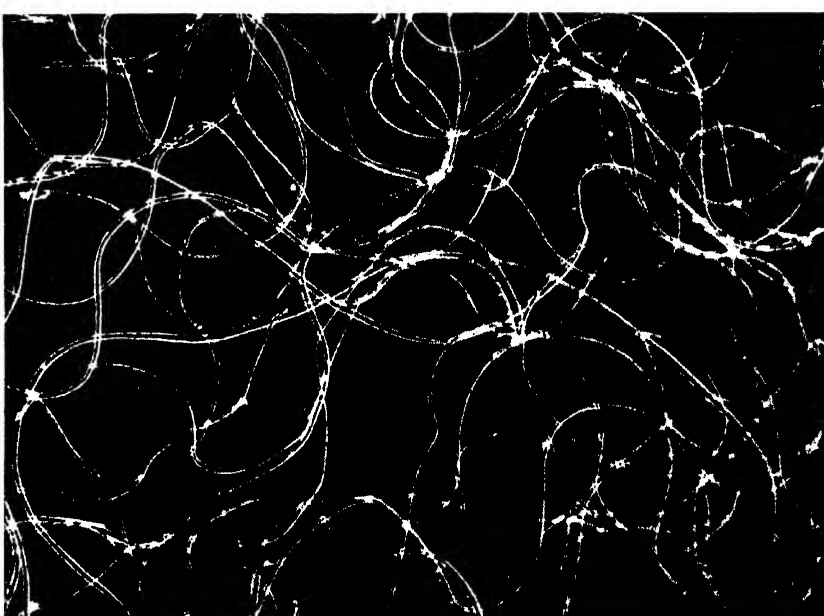


FIG. [illegible] — Rambouillet.

PLATE XXI.

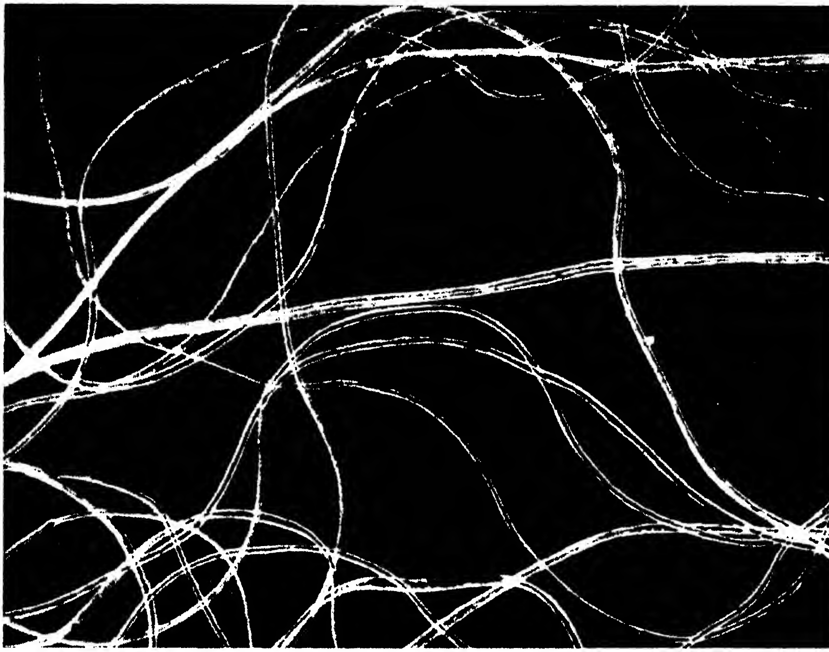


FIG. 73.—Hampshire Down.

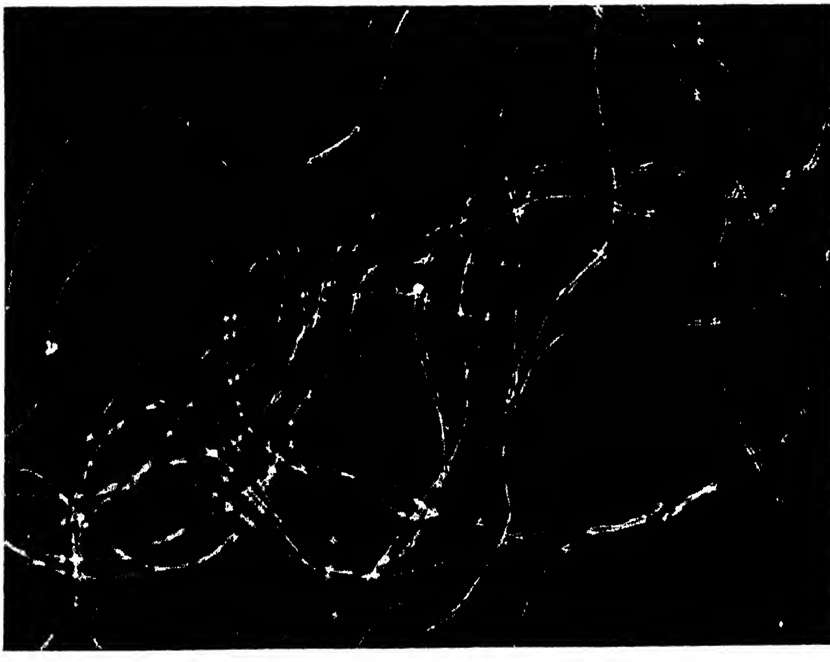


FIG. 74.—Württemberg improved land-sheep.

PLATE XXII.

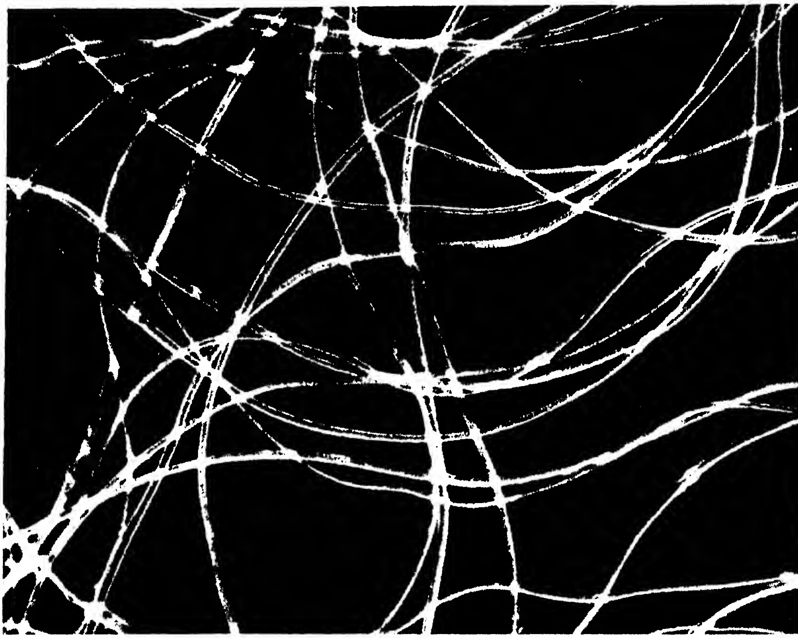


Fig. [illegible] — East Friesian milk-sheep.

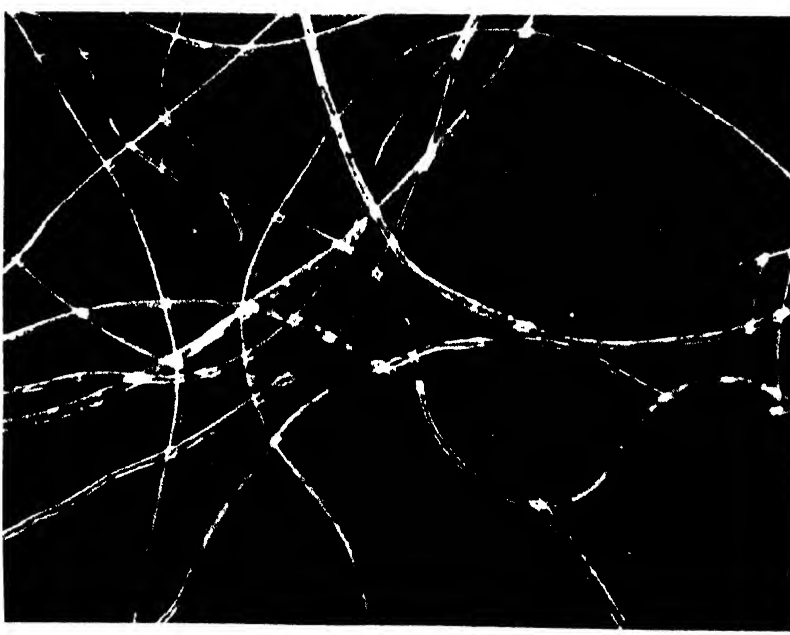


Fig. 74. — Oxfordshire.

PLATE XXIII.

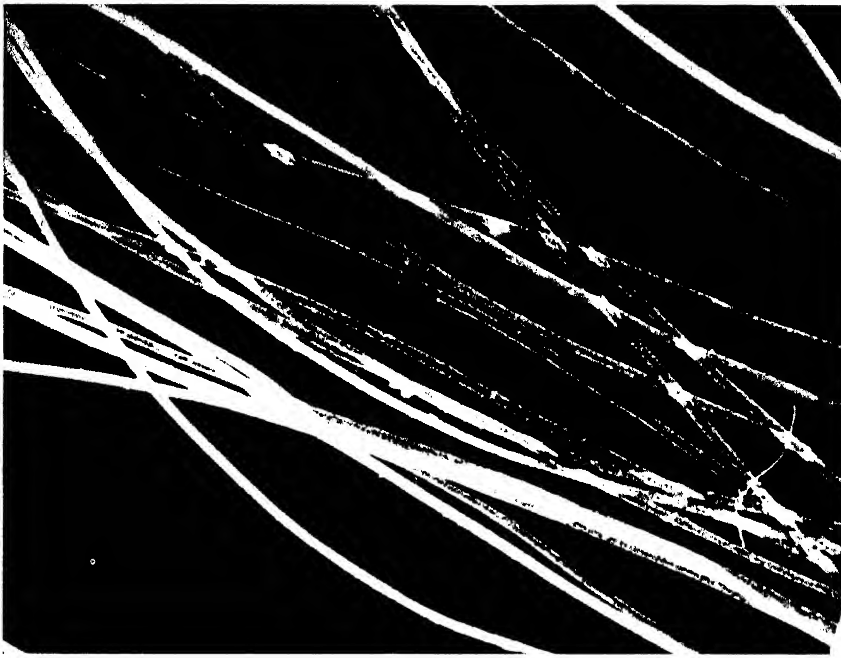


FIG. 77. Stein sheep.

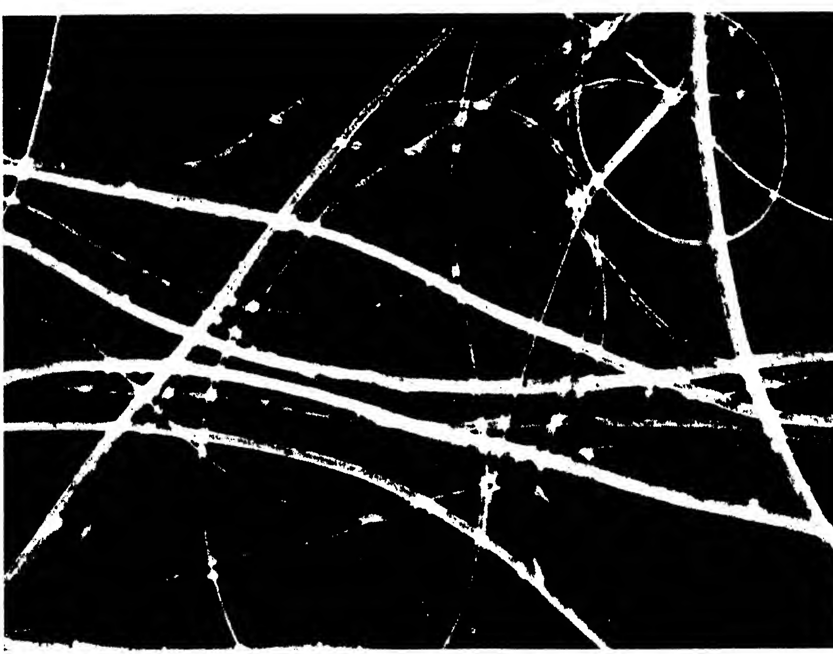


FIG. [illegible]. Hungarian Zackel sheep.

PLATE XXIV.

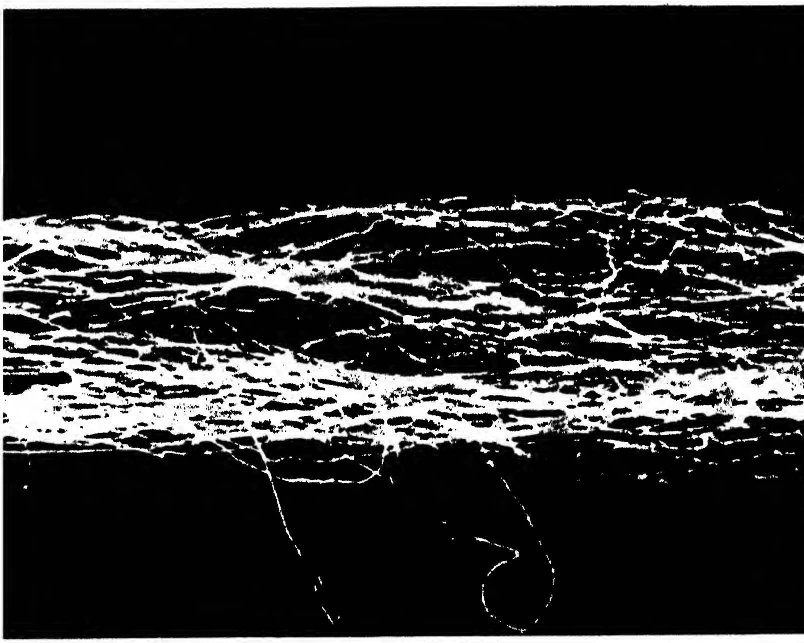


FIG. [illegible].—Cotton yarn.

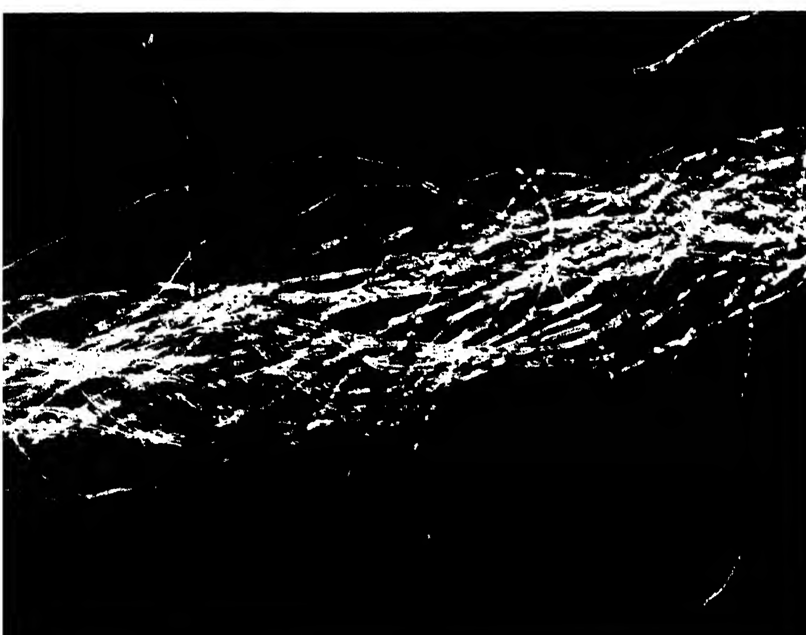


FIG. 58.—1/50 Wool yarn.

sortments, but the fibres will be distributed amongst various classes of thickness. It is then the business of the examiner to find *between* which assortment classes the sample lies with reference to its quality or to which class belong the fibres, which constitute the *greatest part* of the sample. The carrying out of this work may perhaps at first appear rather difficult, but in reality it is not so after a little practice. Everyone who has once seen such a projected wool picture will be astonished how clearly and plainly the wool fibres stand out and how, at the first impression of the picture, the first glance gives great clearness with regard to the composition of the thickness of the fibres, and particularly as to the quality of the sample of wool.

Now, as regards the *examination of yarns* in the apparatus, this can be very valuable in practice. The yarns, as already described, are dealt with according to numbers (relation between length and weight at a definite moisture content). In these number data, however, there is, of course, no direct information available regarding the thickness of fibres, of which the material concerned is composed. One and the same yarn number, therefore, will often turn out differently, according to the delivery. Even if the difference ranges within certain limits, it may have an injurious influence on the process of manufacture. If, therefore, the sample of yarn received from the dealer is examined only once in the apparatus, and that is easily possibile technically, then buying can be done with much greater safety than without previous examination. Spinning mills, felt factories, etc., will often find it necessary to take specimens of their material for examination, in order to expose difficulties in the process of manufacture. Further, of course, all other threads, of vegetable or animal origin (cotton, hemp, silk, artificial silk, etc.), can be examined in the apparatus.

It can be seen, therefore, that the *range of applicability of the Munich examination method* is not confined to the field of wool examination, but also goes further into the process of manufacture. Once the method has proved itself serviceable in practice, then one could at last set about establishing an international unitary valuation table especially for wool, for which the results given by the projection method of examination would serve as a basis. Then, at least to a certain degree, a check would be given to speculation in the *wool trade,* and to much more of the present vagueness. This, however, presupposes of course an *understanding between the agriculturists interested in wool, and commercial and industrial interests.* The initiative

must naturally come from agriculture, because industry has perhaps less interest in such reforms.

From what has been said, it is now necessary, in order to make the advantages of the Munich method accessible to the breeders and industry of the whole world, that a standardisation of wool should be carried out in such a way as to have international validity. For this it is necessary that the qualities of wool chiefly available in the principal producing countries should be compared with one another, and from this the principal standard marks of the world be found or established. For carrying out the standardisation, of course, the experience of commerce and industry, in addition to that of agriculture, must be drawn upon ; for example, there must be considered the principal qualities of wool of the largest wool dealing centres, such as England (London), Australia (Sidney, Brisbane), Cape Colony, South Africa, the Argentine, etc., as also the large spinning mills, and the wool-working and wool-growing countries. The United States of America have already established accurate standard marks, and work in accordance with these in their breeding. In Germany the matter has reached the stage where the *Sonderausschuss für Schafleistungsprüfungen der Deutschen Landwirtschafts-Gesellschaft* (Committee for testing sheep produce of the German Agricultural Assoc.) has recently decided to undertake the work of establishing, in as short a time as possible, a German wool standard, in which the Munich method will be taken into consideration.

The apparatus is at present erected in the laboratory. Negotiations are in progress, however, to make the whole apparatus capable of being taken to pieces so as to be easy for transport and manipulation, and cheap, in short, so to fashion it that there will be practically nothing to hinder its general use. Also the putting of standard pictures directly in the field of vision of the wool sample to be examined is provided for, which will ensure an easy comparison. Naturally, however, it is necessary to carry out first the standardisation of the wools of individual countries.

Nevertheless, I think I have pointed out the way by which, through carrying out the definite establishment of wool statistics throughout the world, there will also be obtained, at any rate in course of time, a classification of wool which will be as accurate as possible, and by which an objective standardisation of wool, of international validity, can be achieved.

AUTHOR'S NOTE.

A long interval has elapsed between the writing and the printing of the above treatise. During this time the Munich method has had to undergo the strongest possible criticism from which it has emerged satisfactorily.

Pronouncements on the usefulness of the method have brought matters so far as to allow the introduction of further improvements of the essential points of which I will here make mention.

For this new apparatus, the Munich method of measuring wool fibres, a magnification of 500 was finally decided on. This magnification was reached by DOEHNER by means of ocular and objective glasses. The combined system is carried out in a tube in front of the « Cüvette ». The ocular glass is specially made for micro-projection and is perfectly corrected. Errors in projection pictures are thereby quite eliminated. The « Cüvette » has also been entirely simplified. It now consists only of 2 glass plates of which one is 2 mm., the other ½ mm. thick. Both run in a metal guide to whose lower end is fastened a container. This is fixed for the reception of the thinned cedar oil. The wool is now simply put between the two glass plates after these have been moistened with cedar oil and then pushed with them into the guide. The metal container, of which we spoke before, is brought to the lower end and partially filled with oil, so preventing a downward escape of the oil from the plates.

The fact that the object and the objective are only separated by a thin glass film of 0.5 mm. ensures a greater clearness than formerly.

The apparatus itself is made by the firm of REICHERT at VIENNA and can be got through Messers LAUTENSCHLAGER — LINDWURMSTRASSE — MUNICH.

The price of the finished product amounts to about 400 marks. (price at time of writing).

The manipulation of the whole apparatus is wonderfully simplified in recognition of the essentially practical use of the instrument.

The arc lamp is replaced by an electric glow lamp and the whole system is made light proof from without, so that daylight examination can now be made.

The whole apparatus is so packed on delivery that one can

take it about with one when travelling. The examination is no longer confined to a special Institute but can be made anywhere one may chance to be, e. g., in the stables, out on the fields, etc.

Exposures can now easily be taken on plates (for the making of prints) and also as was formerly the case on gas light paper.

Dr. H. HENSELER,
Professor and Director of the Institute for Animal Breeding and Breeding Biology of the Technischen Hochschule of Munich.

N. B. — Professor HENSELER has just been asked to study the wool problem by the Australian Government.

THE USE OF SULPHURIC ACID AGAINST WEEDS AND CERTAIN CROP PARASITES

Since 1907 we have been investigating the use of dilute sulphuric acid for the destruction of weeds and various parasites of cultivated plants.

I. — Use of sulphuric acid in fields of cereals.

Utility of the treatment against weeds.

The utility of the treatment against weeds does not require lengthy demonstration. Good agriculturists admit that, on many properties, weeds cause greater losses than frost, hail and parasites. Particularly, deficient crops of cereals are due in great measure to the intense growth of adventitious plants favoured by prolonged periods of rain. This situation draws greater attention to various processes of cleaning lands sown with corn, hoeing of wheat fields, repeated harrowing to pull up certain superficially rooted plants. These operations are not always applicable or effective owing to the want of manual labour or to excessive humidity of the soil. Consequently quicker and less costly methods, such as applications of liquids or caustic powders, have been welcomed.

Agriculturists have especially made use of spraying with 1000 litres per hectare of a 4 per cent. solution of sulphate of copper, or again powder spraying with 300 kilogrs. of anhydrous sulphate of iron. Dilute sulphuric acid has also been recommended. The first trials of sulphuric acid on fields of cereals date back to 1898. Messrs. Bonnet, Brandin and Duclos, who experimented with this product in the Paris district, then concluded that it could not be used in practice.

We have renewed these trials and, by degrees, we have been able to determine the periods of use, the doses of the acid and the precautions to observe. On the whole the results on cereals (wheat, rye, barley and oats) are very satisfactory. Growers now use se-

veral thousands of trucks of acid and some twenty makers manufacture special spraying machines for the application of this new cultural practice.

At dilutions of 5 to 15 per cent. in volume, sulphuric acid is much more active than sulphate of iron, sulphate of copper, sylvinit or sea salt, with which many weeds are not destroyed. It does not cause a partial poisoning of the cereal and a decrease of growth of straw as do copper salts or chlorate of soda and its derivitives. Applied in numerous fields, where it would be serviceable, the process of destruction of weeds which we have investigated, properly used and popularized, could increase the crops of wheat in France by several million quintals.

Action on soils. — Sulphuric acid attacks the mineral or organic matter in soil (very rapidly).

It forms sulphates which, in dry weather, appear as a white powder, recalling that obtained after an application of superphosphate. The action of dilute sulphuric acid on minerals, organic matter and bacteria in the soils has not yet been determined. Fertilisation by acid solutions is always shewn by an increased crop. This fertilising action is also very marked on various crops following immediately the cereal treated, such as turnips and red clover.

However, in a dry soil, the treatment followed by a long dry period may decrease the yield, so that early sprayings are preferable for light soils and in warm regions.

Sulphuric acid is decalcifying in the same degree as sulphate of ammonia and it decomposes a weight of lime approximately equal to its own weight.

Action on weeds — Sulphuric acid is not poisonous ; it is a dehydrating substance. It acts more strongly when the organs acted on are younger, more tender, more swollen with water. Similarly the action is more decided and quicker when the evaporation of the acid solution is more rapid owing to a dry, warm, windy, sunny atmosphere.

With 8 or 10 per cent. solutions of acid at 65° Baumé, many weeds are quickly scorched, viz. those which when young have widespread, soft leaves easily wetted, with terminal buds easily visible at the surface of the soil, for example :—

Ranunculus arvensis ·
Sinapis arvensis
Raphanus Raphanistrum

Matricaria inodora and *M. Chamomilla*
Polygonum aviculare
Medicago apiculata.

Other weeds, more resistant, are destroyed with a strength of 12 to 14 per cent. by volume of acid at 65° Baumé, of 1820 density :—

Papaver Rhoeas
Scandix Pecten-Veneris
Centaurea Cyanus
Borago officinalis
Lychnis Githago
Vicia, Lathyrus, etc.

The action is, moreover, more marked when younger plants are operated on, subject to the condition, however, that they are above ground and quite visible.

The leaves of thistles (*Cirsium arvense*) arranged in a rosette, are badly scorched and the corrosive action even just reaches the underground stem. Under these conditions, instead of producing three or four shoots, as occurs after cutting thistles, the weed puts up, very late, a single thin stem which does not flower and at harvest time scarcely exceeds half the height of the stalks of the cereals.

Unfortunately, all weeds are not killed, and among those which resist the treatment, should be mentioned the bulbous Liliaceae (*Muscari, Allium,* etc.) as well as various harmful Gramineae :— *Agropyrum repens, Agrostis stolonifera alba, Arrhenatherum bulbosum, Lolium temulentum, Avena fatua.*

Action on the cereals. — The cereals are much more resistent to dilute sulphuric acid than most of the weeds and this essential difference explains the results obtained.

In spite of the sorry appearance which immediately follows the application, too much concern should not be shown, nor a hasty conclusion reached. As a matter of fact, cereals with their smooth erect leaves covered with cutin and with their ears hidden in the centre of a sheath, suffer little from the treatment.

The roots, remaining intact, soon repair the damage caused by a kind of nipping. The acid may scorch and whiten two or three of the five or six outer leaves which each cereal plant has at the time of treatment. But, after a fortnight or so, the

plant starts again vigorous, strong and green ; it produces strong stalks and full ears. The maturity of cereals treated with the acid is retarded by a few days and the straw lengthens in the fortnight which precedes harvest. The delay in the upward growth of the wheat decreases lodging. When the treatment is effected early enough, the crop of straw is in no way modified. On the other hand treatment effected too late reduces the height of the stalks.

In the week following the treatment, scatter nitrate and harrow. The fertiliser will produce its full effect on the crop.

Thanks to the treatment, the grains are more abundant, and larger, without mixture of weed seeds, which further increases the selling value of the crop. Moreover, by preventing the weeds from seeding, treatments repeated for several years contribute in a most efficient manner to the permanent cleaning of the soil.

Treatment with acid is easier, quicker and less costly than hoeing cereals ; it acts both on the rows and in between them.

Action on Footrot of Wheat. — Our observations in experimental plots and also in treatment of large crops which deal with thousands of hectares of wheat yearly, have enabled us to note, since 1913, a very marked efficiency of sulphuric acid against Footrot of wheat at least as regards treatment with a strength of 10, 12, or 14 per cent. of acid at 65° Baumé on winter wheats bearing five or six leaves.

In certain cases the difference between the plots was extremely striking. The control plot had numerous stalks bent at the base, almost severed by rot, while on the treated surface it required a long search to find, at the feet of culms remaining erect, a few superficial black spots of *Leptosphaeria herpotrichoides*.

Numerous concordant results obtained in Gascony, Brittany, in the Beauce, etc. confirm this useful effect of the sulphuric acid treatment against the Footrot lodging caused by *Leptosphaeria*. The treatment appears to be equally effective against " Take all " or " White head " Footrot caused by *Ophiobolus graminis* which rots the collar region of the plant.

For the last four years, at the National School of Agriculture at Rennes, all wheats after potatoes, more particularly exposed to attacks of Footrot, are treated with the acid in the second half of March, even in the absence of weeds.

Nature of the acid. — The factories supply acid at 65° Baumé, acid at 60° or acid at 52-53°. These three types of acid may suit.

FIG. 80. — Effect of sulphuric acid at a strength of 10 per cent by volume on some plants (Photograph of 18th April 1912):

(1) Untreated charlock.

(2) Charlock treated on the 5th March: the principal stalk has been scorched.

(3) Wheat plant treated on the 10th February: the plant has not suffered.

(4) Charlock treated on the 10th February and remaining short, stunted and deformed.

(5) *Lathyrus Aphaca*, treated on the 10th February; the stalk, scorched, has not elongated.

FIG. 81. — Field of wheat infested with white charlock (*Raphanus Raphanistrum*), treated on the 5th March 1912 whith sulphuric acid at a strength of 10 per cent by volume. Photograph taken on the 15th April 1912.

A. Control plot, with charlock.

B. Plot treated.

PLATE XXVI.

FIG. 82. — *Action of sulphuric acid on Foot rot (Leptosphoeria).*

Treatment of February 1913 with 1000 litres per hectare of solution at a strength of 10 per cent. of acid at 65° B.

Just before reaping, the stalks are bent and lodged in the control part ; they are erect with large ears, in the treated part.

FIG. 83. — *Action of sulphuric acid on Footrot of wheat.*

Result of a treatment in March 1924, in Beauce, with 1200 litres per hectare of 12 per cent solution by volume of acid at 65° B.

In the foreground, control plot with the stalks lodged.

In the background, treated plot with erect stalks.

The acid at 52° is often the easiest to procure and the most profitable. It is the easiest to handle.

The normal acid at 65-66° B. is slightly more expensive than the other commercial types; but it is pure; it saves packing in carboys and diminishes the cost of transport. The type to be preferred is that which is cheapest per kilo of pure acid; at short distances from the factories this will often be the acid at 52-53° Baumé. 1 litre of acid at 65° is equivalent to 1.25 of acid at 60° or 1.50 of acid at 52°.

Acid strength and quantities of solution. — For winter cereals, the average strength is 10 litres of acid at 65° Baumé per 100 litres of prepared solution the density of which reaches 1100-1110. 1000 to 1200 litres of this solution must be sprayed per hectare of cereals in order to wet them as would a heavy dew.

We have always insisted on the utility of a *preliminary test* which allows us to determine in a few days the suitable strength:— 7, 10, 12, 14 per cent. for winter cereals, according to the kind of weeds to be destroyed and according to the state of the crop.

With oats and spring barley, to be treated for preference when they have two or three leaves in the second half of April in Central France, one gets complete destruction of charlocks or mustards by spraying, on fields rolled and levelled using a sulphuric solution of 1040 to 1045 density; obtained with 4 to 4 ½ litres of acid at 65° or 7 to 8 litres of acid at 52°-53°.

Sulphuric solutions of 1040 to 1045 density do not cause noticeable injury to clovers and lucerne sown in spring in the cereals.

Period of treatment. — Ordinarily, at the time of treatment, the winter wheats, ryes or oats have leaves 10 to 12 centimetres long, to the number of 5 or 6 leaves per plant. The bud is still well buried, but the leaves are already covered with the waxy coating which renders them difficult to wet and very resistant. The soil is still very visible and the weeds to be destroyed have only two or three slightly developed leaves, not hidden under the leaves of the wheat. It is mainly the appearance of the weeds to be destroyed which determines the period of treatment, which must be *in dry weather*, or at least not rainy.

In France, in the South-West, the winter treatments are graduated from the 15th December to the 15th March. In the Centre, the period 1st to 15th April is preferred.

Spring cereals are mainly treated when they have three leaves,

in the second half of April, in France, as soon as the weeds to be scorched are well spread on the ground, without being covered by the cereals.

Preparation of solutions. — The use of a densimeter, for example the mustimeter or must hydrometer graduated from 1000 to 1200 is of real service in the preparation and checking of sulphuric solutions.

In the cultural practice which concerns us, the difference of density due to the rise in temperature, from about 10° to 30° C., is negligible.

The strength of 10 per cent. of acid at 65°, used on winter cereals, corresponds to the density of 1100 to 1110 or 13° Baumé, and all solutions of that density contain the same quantity of pure acid, whatever the commercial acid may be (at 65°, or at 60° or at 53°), which was used in preparing them.

For spring cereals the average strength of 4 per cent. corresponds with a density of 1045 (or 6° Baumé). Consequently it is possible and advantageous to prepare in this way 200 litres of solution :

1) Into a barrel open at one end pour about 150 litres of water ;

2) Add gradually approximately, without weighing or measuring, the dose of commercial acid adopted for 200 litres of solution ;

3) Stir thoroughly with a stick or with the loading pump.

4) Check the density with the densimeter.

5) Fill up to 200 litres, by adding as required a little more acid or a little more water.

6) Stir again and verify the density, average 1100 for winter cereals and 1045 for spring cereals.

Precautions to be taken. — The concentrated acid is dangerous, but 10 per cent. solutions only attack the hands slowly ; the pain however is sharp on cuts or cracks. When the work is continued for several days, the hands are heavily greased, or leather or rubber gloves are used.

The eyes are very sensitive to the action of small drops of acid. The operator stands so that the wind blows the sprayed solution away from him or to one side.

For greater safety the eyes are protected with spectacles, but this precaution is seldom necessary.

To avoid wetting his boots, the operator holds the nozzle of the

spray away from his path. He should also wear sabots and old clothes. Woollen clothes are attacked least.

The workmen should be warned of the danger of the splashing of pure acid caused by the entrance of air into the neck of the carboys when being emptied.

The acid is always poured slowly into a large quantity of water. To prevent dangerous splashing the water should never be poured into the acid. The mixture of acid and water becomes warm. The use of warm solutions, recently prepared, gives more marked results, but the joints or solderings of the apparatus are more corroded.

It is as well to put some pure water near the field, to enable immediate and thorough washing to be done in case of accident.

Results on cereals. — (1) When *winter cereals* have 5 or 6 leaves, from December to mid-April, in the Northern hemisphere, *make a preliminary trial*, then destroy the weeds with solutions containing 8 to 12 litres of sulphuric acid at 65° B. per 100 litres, or an equivalent quantity of sulphuric acid giving a density of about 1100.

(2) For *spring cereals*, when they have 2 or 3 leaves, about a month after sowing, and when the weeds to be scorched are well out, make a preliminary trial and treat with a solution containing 4 or 5 litres of acid at 65° B. per 100 litres, or an equivalent quantity of sulphuric acid giving a solution with density of about 1045.

(3) With an apparatus on wheels it is possible to treat a hectare in two hours at a total cost of less than 100 francs, labour included.

For wheat, the average increase of crops in fields treated varies from 200 to 500 kgs. of grain (per hectare): it is *often much more* and is well worth the cost.

II. — USE OF SULPHURIC ACID ON VARIOUS CROPS.

Without reviewing the various agricultural uses of sulphuric acid, we shall here note its utilization in fields of flax, lucerne and permanent grasslands, for control of Vine Antracnose and for the winter cleaning of fruit trees.

Destruction of weeds in flax fields. — Flax fields with plants 15 centimetres high very much infested with thistles (*Cirsium arvense*), white charlock (*Raphanus Raphanistrum*), sow-thistle (*Sonchus*), were

treated towards the 15th May with 1200 litres per hectare of a solution of sulphuric acid of 10 per cent. strength by volume.

Five days after treatment most of the weeds were completely withered. The stalks of flax, on the other hand, had retained their beautiful green colour and gave a high yield. Flax therefore seems to show at least equal resistance to sulphuric acid as do grasses (G. JANNIN, 1925). A great advance would be made if this expensively weeded crop could be, by means of treatment with acid, sufficiently freed from weeds to enable the harvesting to be done with a reaper-binder.

Use in lucerne fields and grass lands. — In January we treated lucerne fields and permanent grass lands with solutions of sulphuric acid at strengths of 10 per cent. and 15 per cent. by volume.

The slugs (*Limax agrestis*) were killed, blackened and eliminated in 24 hours. The moss, discoloured, yellowish-white, was easily pulled up.

The sow-thistles (*Sonchus*), dead-nettles (*Lamium*), crepis (*Crepis*), the Ribwort plantain (*Plantago lanceolata*) had disappeared. The destruction of the crepis and the plantains is of real importance.

The lucerne shoots, 2 cm. long, were scorched with consequent retarded growth in January and February. But by the 20th March the treated lucerne was as fine as the untreated. Tests are to be renewed at an earlier date and with various strengths.

Destruction of dodder. — In the month of August we sprayed patches of dodder in a lucerne field with a solution of sulphuric acid at a strength of 8 per cent. by volume. The filaments of the parasite immediately became darker in colour, golden yellow, and then soft, sticky and withered.

The lucerne wetted by the solution was completely whitened. But the buds of the collet, slightly underground, were not scorched. After a fortnight, the tufts which were not too much exhausted by the successive action of the dodder and the acid began to grow again, without the dodder.

The result, however, is rarely complete, for it is necessary to soak all the filaments of the parasite without exception, otherwise fresh patches appear, either by the growth of the surviving filaments or by the germination of fresh seeds. The results are improved by cutting first of all the patches of dodder for 0.50 m. beyond the outermost filaments, removing the cut stems in a cloth, and then watering with an 8 per cent. solution of the acid.

Washes against Vine Anthracnose. — The use of acid solutions in vine growing has been known for a long time.

This process, however, did not become general until about 1910. For a long time, washing with solutions of sulphate of iron at a strength of 30 per cent. with 2 litres of sulphuric acid added to it, was used against Vine Anthracnose.

Now, vine-dressers give preference to simple solutions of sulphuric acid, prepared by pouring 5 or 6 litres of acid into 100 litres of water.

The solution is applied, either with a brush or with a leaden sprayer, in the month of March twenty days before the swelling of the young shoots. We have noted that the start of growth is retarded by ten to fifteen days, which to that extent decreases the risk of white frosts.

The bark disintegrates and falls, especially after two or three years of treatment. This cleansing does away with the winter resting places selected by *Sparganothis pilleriana*, *Conchylis ambiguella* and *Polychrosis botrana*.

Winter cleaning of fruit trees. — A solution of acid at a strength of 5 per cent. by volume was sprayed in January by means of long nozzles on the trunks and branches of various fruit trees.

The lichens and moss were reduced to the state of a grey, granular powder which is very quickly detached, leaving the bark smooth and bare.

The acid also destroys *Protococcus viridis*, an alga of small round cells which covers the trunks of trees with a greenish coat, particularly on the side exposed to rain.

Many germs of parasites (*Monilia cinerea*, *Puccinia Pruni*) may thus be destroyed by sulphuric acid. Perhaps this is also the case with the eggs of certain insects, such as *Cheimatobia brumata*.

On the other hand, the external tissues of the bark even on fairly old branches remain green for a long time, full of chlorophyl. It is permissible to think that this chlorophyl intervenes in the nutrition of the tree, subject however to the condition that the sun's rays can reach it, without being intercepted by a screen of lichens. With two or three litres of acid solutions, a tall fruit tree of medium size can be thoroughly wetted in winter by means of a sprayer. In our experiments the buds of cherry trees, pear trees and plum trees have in no way suffered from treatment at a strength

of 5 per cent. of acid by volume and flowering took place under good conditions.

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To sum up, sprayings with dilute sulphuric acid act as fertilisers of the soil, as destroyers of many weeds, and of many crop parasites, notably the fungus which causes Footrot of Wheat.

The list of the uses of sulphuric acid in agriculture is not completed, and various methods of application may be considered. Thus we have found a stronger weed-killing action and a more marked fertilising action by the addition of sulphate of ammonia to the sulphuric acid solution. Nitrate of soda acts similarly. Liquid fertilisers, to be used in small quantities, are at the same time distributed with an evenness difficult to obtain otherwise.

In Italy, at Perugia, MORETTINI brought to notice, between 1913 and 1915 the good effects of the sulphuric acid treatment on wheat, and the late savant GIGLIOLI, of the University of Pisa shewed the excellent results obtained by the use of sulphuric acid diluted with fresh urine (1916).

French manufacturers have studied simple strong apparatus made with materials which stand dilute acid well (wood, rubber, lead, special bronzes) and which allow of a good spraying of 800 to 1500 litres or more of solution per hectare being made in a single transit. The contents of the barrels varies according to the average length of the fields in each region, so as to avoid both too frequent replenishments and the too prolonged transport of an excessive load.

According to circumstances, the pump compresses the air in the barrel above the acid solution, or else it forces the solution itself into the compression chamber.

In France, for the past twenty years, the use of sulphuric acid in fields of cereals has been popularized by the Agricultural Services and Associations, Agricultural officials, manufacturers of apparatus and spraying contractors. In the Department of Seine-et-Oise Syndicates have been formed for the control of crop pests, and their usual procedure is a methodical organisation of sprayings with sulphuric acid.

Elsewhere, Syndicates for a common stock of machines or Municipalities have purchased a sprayer on wheels, which is used

for the spraying of acid solutions for the treatment of vines and potatoes with Bordeaux mixture and for weed killing in streets and pavements with a 2 per cent. solution of chlorate of soda.

The method which we recommend has also been applied with success in Italy, Algeria, Australia, Belgium, England, the Argentine Republic, etc.

We should be glad if the publication of these few results in the *Review* of the International Institute of Agriculture encouraged inquirers in various countries to adapt the methods of application of dilute sulphuric acid to local conditions of agriculture.

Moreover, the questions here raised could form the object of methodical research in the special Stations which, besides documentation and propaganda work, prosecute researches on the biology of weeds and on the various processes of control cultural, mechanical, physical and chemical.

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INTERNATIONAL ASSOCIATIONS

PROCEEDINGS OF THE INTERNATIONAL SOCIETY OF SOIL SCIENCE

Papers.

THE EFFECT OF LIME AND FERTILISERS ON THE POTASH CONTENT OF SOIL AND CROP.

During the past 25 or 30 years many thousands of soil and crop samples have been analysed by the various experiment stations in the United States. Many of these analyses have been published in bulletins, books and journals. In some cases authors have compiled analyses from various sources, including work done in foreign countries. Probably in the majority of cases no record has been made of the type of soil, or of the fertiliser treatment that was given to the particular crop from which the sample was taken. It is well known, however, that the composition of the crop may be distinctly influenced by the fertiliser treatment, and since it has become quite customary to calculate the amount of plant food removed by a given crop by reference to such tables of analyses, the importance of having reliable information with regard to the soil type and fertiliser treatment is at once apparent. Otherwise the value of such calculations may well be called in question.

If, for example, the dry stalks of corn (maize) grown under one condition show on analysis 1 per cent of potash and under different conditions 3 per cent of potash, how can one fairly calculate the amount of potash removed by one ton of the stalks grown under average conditions without knowing which sample most nearly represents this average condition? In the one case a ton of the stalks would remove 20 pounds of potash and in the other 60 pounds.

In studying the analyses of crops from the nitrogen availability experiments at the New Jersey Experiment Station, it became evident that in many cases the compositions of the crop had been dis-

tinctly influenced by the fertiliser or lime treatment. Since these experiments have established conditions which are especially favourable for such a study, it seems well to record some of the results obtained from field experiments which have been in progress since 1908.

PLAN OF EXPERIMENT.

In connection with the nitrogen availability work, 40 one-twentieth acre plots have received definite fertiliser treatments annually. Twenty of these have been limed (carbonate) at intervals of five years, and 20 have received no lime treatment during the period. Some of the plots have received no fertiliser, some have received one ingredient only, some two, others two plus farm manure, and still others three of the common fertiliser ingredients both with and without manure.

The soil is a loam of fair quality, which had not been farmed for some years preceding the starting of this work in 1908.

With the completion of 15 years work, which includes the crop of 1922, samples of soil were taken from these plots (1) and their potash content was determined. Potash has also been determined in the corn stalks taken from these plots in 1923, and in samples of some other crops from these plots as indicated in table 2.

POTASH IN SOILS.

Table 1 shows the fertiliser and lime treatments that these plots have received and also the percentage of potash in the soil and in the corresponding crop. An examination of the figures for the soils shows that in nearly every case the percentage of potash is lower in samples from the limed than from the unlimed series, the average for the limed plots being 1.088 per cent and for the unlimed 1.268 per cent. The differences noted here can hardly be due to accident but must be attributed to the differences in treatment. The lower percentage of potash on the limed series is undoubtedly due, in part at least to the exchange of bases, the lime of the applied limestone taking the place of the potash in the soil. Since the crops on the majority of these limed plots have been only slightly larger than those on the unlimed series, the difference could hardly be attributed to the greater utilization of potash on the limed series.

(1) Samples taken to the depth of about 6 $^2/_3$ inches.

TABLE I. — *Potash (K_2O) in soils and in corn stalks from corresponding unlimed and limed plots, with different fertiliser treatments.*

Plot No.	Fertiliser treatment (per acre)	K_2O in soils-1922		K_2O in corn stalks 1923			
		Unlimed (A)	Limed (B)	Unlimed (A)		Limed (B)	
		per cent	per cent	per cent	lbs per acre	per cent	lbs per acre
1	Nothing	1.364	1.038	0.779	14.49	0.604	14.13
2	320 lbs muriate of potash	1.371	1.030	2.177	43.98	1.838	48.52
3	640 lbs acid phosphate	1.464	0.984	1.406	28.12	0.426	10.99
4	Minerals *) only	1.426	1.031	2.346	59.12	1.834	67.86
5	» + 16 tons cow manure	1.186	0.953	2.872	83.29	2.246	83.10
6	» + 16 tons horse manure	1.395	1.228	3.200	94.72	2.636	106.49
7	Nothing	0.742	1.085	0.593	5.04	0.618	17.92
8	Minerals + 160 lbs. $NaNO_3$	1.310	1.186	2.784	75.17	2.345	81.14
9	» + 320 » $NaNO_3$	1.267	1.015	3.185	87.27	2.014	66.86
10	» + $Ca(NO_3)_2$ **)	1.353	1.046	3.181	87.16	1.832	67.05
11	» + $(NH_4)_2SO_4$ **)	1.189	1.038	2.278	19.14	1.949	61.98
12	» + $CaCn_2$ **)	1.216	1.104	3.208	102.01	2.090	68.55
13	» + Blood **)	1.453	1.036	1.960	62.72	1.968	62.98
14	» + Ground fish **)	1.650	1.100	2.172	58.21	2.175	73.52
15	» + Tankage **)	1.034	0.938	1.997	64.30	2.478	98.62
16	» + 2 tons alfalfa hay	1.062	1.050	2.549	68.31	1.831	49.07
17	» + 2 tons rye straw	1.445	1.356	2.488	68.67	2.435	90.58
18	» + Cow manure + 320 lbs. $NaNO_3$	1.085	1.228	2.832	104.22	2.218	85.17
19	» Only	1.135	1.093	2.674	82.89	2.794	89.97
20	» + Rye straw + 320 lbs. $NaNO_3$	1.216	1.220	2.185	62.05	3.103	98.68
	Average	1.268	1.088	2.343	63.54	1.972	67.16

*) Minerals = 640 lbs. acid phosphate and 320 lbs. muriate of potash per acre.
**) Equivalent to 320 pounds $NaNO_3$ per acre.

On the other hand there are differences within the series which are probably due to inequalities in the soil or to errors in sampling, or both. That these differences within the series are not due to the potash treatment is shown by comparing the results from plots 2 and 3 unlimed (A's) with 2 and 3 limed (B's). Plots 2 A and 2 B have received annual applications of muriate of potash equivalent to 320 pounds per acre for about 15 years, whereas plots 3 A and 3 B have received no potash fertiliser during this period. It will be noted, however, that in the case of 2 A and 3 A the difference in potash content is easily within the limits of experimental error ; the same may be said of 2 B and 3 B. To take another example, plot 4 B receives the annual application of muriate of potash and plot 5 A receives the same plus an annual application of manure, which adds about as much potash as the muriate (160 pounds per acre), but on analysis 5 A shows a lower percentage of potash than 4 A. In this case the difference may be due, in part at least, to the fact that 5 A has always yielded larger crops than 4 A, as shown by the total potash removed.

In case of plot 7 A which receives no fertiliser it would appear that the potash content of this soil has been distinctly depleted during the 15 years, for it now contains only a little over half as much as plots 6 A and 8 A, these being the plots which touch it on either side. There are other differences which should probably be explained on the ground of a difference in location rather than differences in treatment. For example, plot 14 A contains 1.65 per cent potash and 15 A, 1.034 per cent potash, but these plots are separated from one another by two one-twentieth acre plots, and furthermore 14 A occupies a little lower ground than 15 A.

Potash was determined in certain of the subsoils (6-13 in.) with the following results :

Plot No.	Unlimed (A) per cent	Limed (B) per cent
2	1.467	1.178
3	1.569	1.383
7	1.122	1.046
14	1.530	1.399
20	1.399	1.159
Average	1.417	1.233

Potash Content of Corn Stalks.

When we study the percentage of potash in the stalks from the different plots, we find a much greater difference than was found in the soil. A comparison of the results for the two sections shows that in the majority of cases the percentage of potash is higher in samples from the unlimed than from the limed section. It will be recalled that this same relation exists between the soils of the section, but it hardly seems possible that this difference in the soils is great enough to influence the potash content of the stalks to the extent that is here noted.

Attention may be called to some of the striking differences. For example, sample 2 A contains approximately one and a half times as much potash as 3 A, and 2 B contains over three times as much as 3 B. Samples 6 A, 10 A and 12 A contain close to eight times as much potash as sample 3 B. Sample 13 A contains the same amount of potash as 13 B, and 14 A the same as 14 B; on the other hand 15 A and 15 B differ by about .5 per cent; although they are quite close together and have received the same potash treatment. Samples 7 A and 7 B (no fertiliser) contain about .6 per cent potash while samples 6 A and 6 B, the adjoning plots respectively on the one side, and 8 A and 8B the adjoning plots respectively on the other side, contain about 2.75 per cent potash.

The lowest percentage of potash is .436, representing sample 3 B, which is equivalent to 8 ½ pounds of potash to the ton of stalks; the highest percentage shown is 3.208 for sample 12 A, which is equivalent to 55.6 pounds of potash to the ton of stalks.

There is a considerable variation even where the potash treatment has been uniform. Samples 9 A, 10 A, and 12 A show over 3 per cent of potash, whereas sample 17 A, which receives the same amount of muriate of potash as the others shows only 2.28 per cent of potash. It is difficult to reconcile some of these differences. That it cannot be due wholly to the natural supply of potash in the soil is indicated by the fact that the soils from 16 A and 16 B contain almost exactly the same amount of potash, whereas the stalks from these two plots differ by almost .75 per cent. Neither can it be attributed to a difference in the amount of available nitrogen, for 18 A receives a large excess of available nitrogen, whereas 19 A receives

no nitrogen, but the potash content of the stalks is very nearly the same in each case.

It seems worth while to call attention to the fact that for the unlimed section the samples from the six plots which have received a basic nitrogenous fertiliser ($NaNO_3$, $Ca(NO_3)_2$ or $CaCn_2$) give an average of 2.896 per cent potash, while the samples from the five plots that have received an organic nitrogenous fertiliser give an average of 2.233 per cent potash. For the limed section the corresponding figures are 2.267 and 2.177 per cent potash. In this connection it is interesting to speculate as to whether, through an exchange of bases, soil potash was released and in turn taken up by the plant.

The average percentage of potash for all samples from the unlimed section is 2.343 per cent, and the average for all from the limed section 1.972 per cent. Here we may raise the question as to why stalks from the limed section should contain less potash than those from the unlimed section. It may be that the repeated applications of lime, having helped to reduce the potash content of the soil, particularly the more readily displaceable portion of it, discouraged excess (luxury) consumption of this ingredient. With our present knowledge a positive answer cannot be given. It may also be that on the limed section a part of the plant's basic requirement has been met by the utilization of lime to the exclusion of a part of the potash. Determinations of the lime content of the plant may throw some light on this point. Lime was determined in a limited number of samples from both the limed and unlimed sections, and without exception the percentage of lime (CaO) is higher in samples from the limed than from the unlimed section ; with one exception the reverse is true of the potash. Further work should be done on this point but this gives some ground for believing that in the presence of a liberal supply of lime the plant may take less potash than where the supply of lime is limited. The comparative lime and potash figures are shown in Table 2.

Reference to the columns showing pounds of potash removed per acre by the corn stalks, makes it clear that there is a wide variation in the amount thus removed, the lowest for the unlimed series being 5.04 pounds and the highest 104.22 pounds per acre ; the lowest for the limed series is 10.99 pounds and the highest 106.49 pounds per acre.

TABLE 2. — *Lime (CaO) and Potash (K_2O) in Corn Stalks from Limed and Unlimed Plots.*

Plot No.	CaO in Stalks		K_2O in Stalks	
	Unlimed per cent	Limed per cent	Unlimed per cent	Limed per cent
3	0.823	0.885	1.406	0.426
10	0.660	0.881	3.181	1.832
21 * and 22	0.694	0.918	2.112	1.362
35 * » 38	0.751	0.800	2.897	3.210
42 * » 45	0.844	1.151	1.844	0.926
Average . . .	0.754	0.907	2.288	1.551

The first number in each case represents the unlimed plot.

Plots 8 to 15 inclusive received like treatment with reference to potash, and the average amount removed in the stalks from these plots, on the unlimed section (plot 11 A omitted from average), is 76.7 pounds per acre, the average amount removed in the stalks from plots 8 to 15 of the limed section is 72.6 pounds per acre. The average for all the plots in the unlimed section is 63.54 pounds per acre, and the average for all in the limed section 67.16 pounds per acre.

The stalks from plots 8 to 15 of the limed section yielded, with slight exception, somewat over 50 bushels of corn per acre. Thus it appears that the stalks from a 50 bushel crop of corn will remove about 75 to 100 pounds of potash. To this must be added about 12 pounds for the 50 bushels of grain. This brings the total amount well above the amount usually estimated for a 50 bushel crop of corn. The figures clearly indicate that in the case of some crops, or part of crops, it is useless to undertake to calculate the amount of potash removed by the crop unless the soil conditions and crop treatment are definitely stated.

POTASH IN OTHER CROPS.

Determinations of potash have been made in other crops or parts of crops, from certain of these plots. The samples on which determinations were made, were wheat straw, oat straw, oat grain, timothy hay and corn grain. The details of these analyses will not

be given here. It will suffice to state that the influence of the fertiliser and lime treatment is not as clearly and consistently reflected in the composition of the small grained plants as it is in the composition of the corn stalks. Nevertheless even here applications of potash salts increased, and applications of lime decreased, in most instances, the potash content of the crop.

Summary.

Potash was determined in soils from a number of plots that had received definite fertiliser and lime treatment for a period of 15 years. It was also determined in several crops, or parts of crops, grown on the plots from which the soil samples were taken.

For the series of plots having parallel fertiliser treatment for the limed and unlimed sections, the percentage of potash in the soil was slightly lower, in nearly all cases, for the limed than for the unlimed section.

The fertiliser treatment does not appear to have had very much influence on the potash content of the soil. Such variations as are noted are to be attributed, in the main, to natural variations in the soil or to limitations in the methods of sampling.

There is a consistent variation in the percentage of potash in the corn stalks grown on the limed and unlimed sections and with the different fertiliser treatments.

The average percentage of potash in the stalks from 20 limed plots is, approximately, 0.4 per cent less than the average for the stalks from 20 limed plots.

The lowest percentage of potash found in the stalks was 0.426 per cent, and the highest 3.208 per cent.

It would appear that a 50 bushel crop of corn (maize), grain and stalks, will remove from the soil about 100 pounds of potash. It has been shown that the potash content of some crop, at least, is greatly influenced by heavy applications of potash salts and this emphazises the importance of carefully stating the conditions under which crops are grown when reporting percentages of plant food constituents in the crops.

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ON THE PERMEABILITY OF CLAY SOILS.

I. — The formulation of the question and the methods of the investigation.

In my earlier investigations 1) I established the fact that the suspensions of the finest particles of soil produced from acid soils are much less sensitive to electrolytes than are the clay suspensions of neutral soils and soils containing $CaCO_3$. There is also the circumstance that the coagulation of the former clay suspensions is hindered much more powerfully by $NaHCO_3$, if this is in the solution together with calcium salts. As the permeability of the soil is connected with its degree of dispersiveness, it is conceivable that the low permeability of podsol soils, as regards water, is connected with the reaction, and consequently also with the formation process of these soils. The numerous data of analyses of podsol soils of various districts show that the development levels of different depths have also different mechanical and chemical composition. In this respect the podsol soils both of the Caucasus, which have developed at a yearly temperature of 12° C., and of the Italian Apennines, form no exception. The upper levels of the soil ($A_1 + A_2$) have not only lost their finest constituent parts, but also considerable quantities of Na and K, and even the coarser grains of the felspar and other minerals. The surface of the felspar of the upper level is always covered with a white or grey weathering skin. The Na_2O — and partly also K_2O — content of the skin is considerably reduced (1). The whole upper level ($A_1 + A_2$) has in some cases lost as much as 0.25 % K_2O and 0.5 % Na_2O, which, calculated on 1 hectare, means very large quantities of $NaHCO_3$ and $KHCO_3$. We now also find actually in the underground and surface waters very large Na_2O and K_2O contents, which have a detrimental effect on the physical qualities of the soil, and may reduce its permeability for water. The content of $NaHCO_3$ is especially high in the brown forest water, often exceeding 0.1-0.25 g. per litre, i. e., it reaches a concentration of about 0.0012-0.0030 n, which already has an injurious effect.

1) The work had to be abbreviated for editorial reasons; the literature cited by the author is appended at the close of the essay.

The object of the investigation was to find out the factors which reduce or increase the permeability of various kinds of podsol soils. The experiments were carried out with different levels of the podsol soil, especially with marl loams. The latter are often found in Latvia, and are to be regarded as mother-stone loamy podsol soils. All the experiments were carried out with pulverized air-dried soil, granulated through a 1 mm. sieve. Grains of 1-2 mm. diam. only were used in tests regarding the permanence of the structure of the soils, the finer constituent parts being sieved off in this case.

After numerous preliminary tests, I found the following apparatus the most suitable (Illustration 84). The apparatus consists of a bottle or Erlenmeyer flask, a little tube with perforated end (the perforation is very simple to carry out on a spirit lamp with a blowpipe) and a round flask containing 100-400 ccm. Instead of the latter, a bottle with a perforated stopper can be used. A glass tube 6-8 cm. long by 0.8-1.0 cm. diam. comes into the stopper. I used 10 g. of soil for the tests. The soil came into the tube, the perforated end of which was covered with a little wadding. It is an advantage also to draw the wadding into the hole with the aid of a small wire. The tubes were the usual 16 cm. long and 1.6 cm. diameter. These glasses are also advantageous because their diameter is 2cm^2, which facilitates the calculation of the filtrate corresponding to the depth of the water layer, as the deposits are designated: 2 ccm. of the filtrate corresponding to 10 mm. of the deposit. 10 g. of soil occupy about 4.5-5.5 cm. of the length of the tube, according to the density of the soil. In filling the soil into the tube I mixed it up again by turning the tube round. After filling, the little tubes were furnished with a rubber ring, a piece cut off a rubber pipe, with an edge which was not smooth, so that the air should not be cut off. The rubber ring does not allow the little tube to sink into

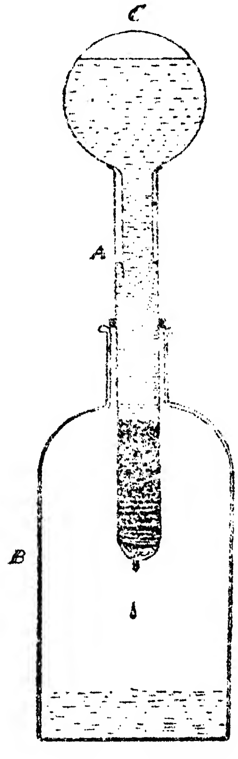

FIG. 84. — Apparatus for investigation of permeability.

the bottle or Erlenmeyer flask. Then the tube is filled with water over the soil, up to 12 cm. from the lower end of the tube. The third part of the apparatus is a round flask, which holds water to a certain height. The little flask is filled with water or with the salt solution to be examined, and stuck into the tube neck downwards. If the water in the tube sinks so far that air comes between the tube and the neck of the flask, then the air will immediately penetrate into the flask, and a sufficient quantity of water will flow out into the little tube to again shut off the neck of the flask from the air. The principle of the apparatus can also be adapted to sand and other materials easily permeable by water; in this case a larger bottle must be used, into which the little tube goes, and a larger round flask for holding the water or salt. In this case the round flask must be fixed to a support, as the little tube may break in pieces if the flask contains more than 400 ccm. of liquid. In order that the water can easily flow out of the flask into the tube, the neck of the flask must have a diameter of about 0.8-1.0 cm., and be cut off obliquely at the end.

After a few preliminary experiments I have found the best amount to be 10 g. of soil in conjunction with a depth of filtering material of about 5 cm. If the filtering layer is deeper, then relatively small quantities of filtrate are obtained ; if the latter is smaller, however, then the finest constituent parts of the soil are many times vigorously washed, and those salt solutions which increase the degree of dispersiveness filter even more quickly than distilled water. This circumstance is of especial significance in the experiments with « Gley » soils : thus, for example, the filtration through a layer of « Gley » soil 5 cm. deep was distinctly retarded by a 0.0001 n $NaHCO_3$ solution, but the filtration through a layer 2 cm. deep of the same soil was furthered because in the first case the pores were stopped up by the finest constituent parts of the soil, whereas in the second case these finest constituent parts were washed out, and filtration consequently increased. The quantities of water filtered through the soil were measured, the measurement being for the most part carried out once a day. In the tests extending over several months, even two years, the measurements were carried out more seldom, every two days, and in some cases every twenty days.

With good mixing of the soil, and good filling, the parallel measurements give mostly correspondingly good results, especially good with marl loams and neutral soils. With very acid soils, the deviations fo the parallel determinations are greater, especially with the examina-

tion of such solutions as increase the degree of dispersiveness of the finest constituent parts of the soil. The differences in the quantities of filtrate are in this case particularly great for a single day, whereas the total quantity of filtrate for a longer period shows small differences in the parallel determinations. The alterations in permeability apparently are here very erratic, being suddenly reduced or increased. That is quite comprehensible; if the finest particles are taken out of the soil with the filtrate, then stopping up or freeing of the pores occurs, which requires no special explanation. The methods described for investigating permeability cannot give results which are equal in accuracy to those obtained by the methods of analytical chemistry. Still, even with these methods, very many complicated questions can be answered. This method withal is very simple, requires no expensive apparatus, no great space, and is suitable for carrying out very numerous parallel examinations of long duration. In the simply equipped laboratory I have carried out up to now about 300 such examinations, lasting at least a month each, which have already led to many important conclusions, and these I will consider briefly in the present work.

With such an apparatus, the influence of the water pressure on filtration, and the stopping up of the pores, can be demonstrated in lectures, by the use of quartz sand (grains about 0.15 mm.) as a filtering layer and diluted clay suspensions for filtration. To obtain greater water pressure, instead of the little tube a longer piece of corresponding glass tube can be used.

II. — Experiments with marl loams.

Three different kinds of marl loam have been examined. I. Band clay of about 3 m. deep, with a $CaCO_3$ content of 28.37 %. The sample of soil originates in the district of Tuckum, in the neighbourhood of Renge. II. Band clay from the neighbourhood of Kauzmünde, of a depth of 50-60 cm., $CaCO_3$ content 4.02 %. On the band clay was a little changed neutral soil similar toRendzine soil. The $CaCO_3$ content of the deeper layers of band clay rises to 20 % ; therefore the upper layers of the band clay must be considered as pretty strongly washed out, having lost up to 16 % of their original $CaCO_3$ contents. III. Unstratified marl loam of a depth of 60-70 cm., from the neighbourhood of Kursichi, district of Goldingen. Typical podsol soils have already formed on the marl loam.

All three marl loams mentioned are very rich in the finest constituent parts of soil, clay particles which do not deposit in the course of 24 hours from a suspension 10 cm. deep ; this is particularly so with the last two samples of soil. This is seen from the following data :

TABLE I. — *Mechanical composition of the marl loam.*

Size of grain *) in mm.	Time of deposit	I	II	III
		%	%	%
1 — 0.05 mm.	1 minute	0.47	7.24	48.57
0.05 — 0.01 mm.	10 »	16.48	19.0	14.03
0.01 — 0.005 mm.	6 hours	41.91	—	17.11
0.005 — 0.001 mm.	24 »	11.70	73.76	5.76
under — 0.001 mm.	—	23.44	—	14.63

The size of grain is designated after Prof. W. R. WILLIAMS, *Nachrichten der Akademie Petroffskaja* 1889. The microscopic check has shewn that the size of grain is somewhat different, thus for example, particles whose diameter is rather smaller, about 0.003 mm, are deposited in 6 hours. The samples of soil were in this case prepared for mechanical analysis by heating slowly with a few drops of NH_3. The $CaCO_3$ was not separated. All further mechanical analyses carried out in this treatise are obtained with ammonia without heating. The samples of soil were however prepared by treatment with NaCl normal solution after Prof. K. GEDROIZ.

The two first marl loams contained no constituent parts which were larger than 1 mm., the last sample contained 17.2 % of such ; these particles were, however, granulated, and for the tests only soil was used which had been put through a 1 mm. sieve.

Although the loams contain fairly large quantities of constituent parts which were not deposited in the course of 24 hours, yet the ultra-mechanical constituent which is not deposited within three weeks could not be obtained by treating the soil several times with normal NaCl solution in accordance with the methods of GEDROIZ (2). After the washing out of the NaCl, fairly large quantities of Ca ions passed over into the solution, by which the finest constituent parts were pretty quickly coagulated. The explanation of this fact must indeed be sought in the influence of the NaCl on the $CaCO_3$; this raises the hydrolytic decomposition of the $CaCO_3$. My last investigations show that with $NaHCO_3$ and NH_3 better results can be obtained, because the $NaHCO_3$ and NH_3 reduce the hydrolysis of $CaCO_3$.

(a) *Experiments with band clay of the deeper layers of soil from Renge.* — The results are to be seen from the curve of Illustration 85, in which the quantities of filtrate which passed through the soil in the first 21 days are set out graphically. The quantities of filtrate are shewn on the ordinate axis, the days on the abscissa axis. The experiments were carried out with : I. distilled water, II. saturated Ca $(HCO_3)_2$ solution of about 0.02 normality ; the solution also contained free CO_2, III. CaSO4 solution of 0.012 normality ,IV. with water saturated with CO_2 (about 1 g. CO_2 to the litre).

The permeability was lowest for distilled water, but also very constant at about 3 ccm. per day ; only in the last weeks of the experiment did the permeability rise to 4 ccm. per day.

The permeability for $Ca(HCO_3)_2$ solution was also low; it was

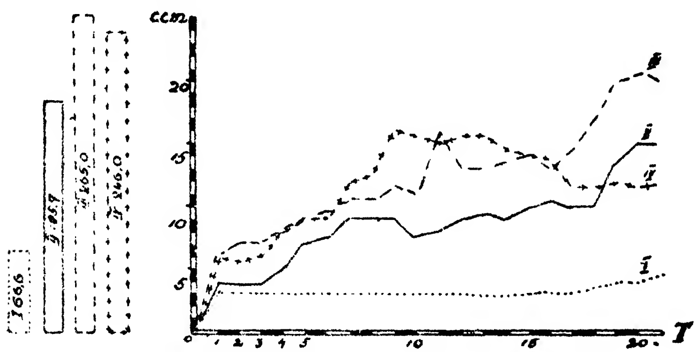

FIG. 85. — Experiments with band clay from Renge.

I. .... Distilled water.
II. ———— 0.02 n Ca $(HCO_3)_2$ solution.
III. -------------- 0.012 n $CaSO_4$ solution.
IV. +-+-+ +-+ CO_2 = solution about 0.5 = 1 g. CO_2 per litre.
Left = Total quantity of filtrate in 21 days.

only at the end of the experiment that a quick rise of permeability was noticeable.

The greatest quantities of filtrate were obtained with $CaSO_4$ solution ; in this case also a quick rise in the permeability is observable at the end of the experiment.

With water saturated with CO_2 a quick increase in permeability was produced in the first nine days of the experiment ; afterwards the permeability became gradually lower.

(b) *Experiments with band clay from Kauzmünde. ($CaCO_3$ = 4.02 %.* — The results of the experiments are graphically represented

in Illustration 86. These come very near to those of the first band clay, especially with distilled water. The influence of the electrolytes $CaSO_4$ and $Ca(HCO_3)_2$ was in this case greater from the very be-

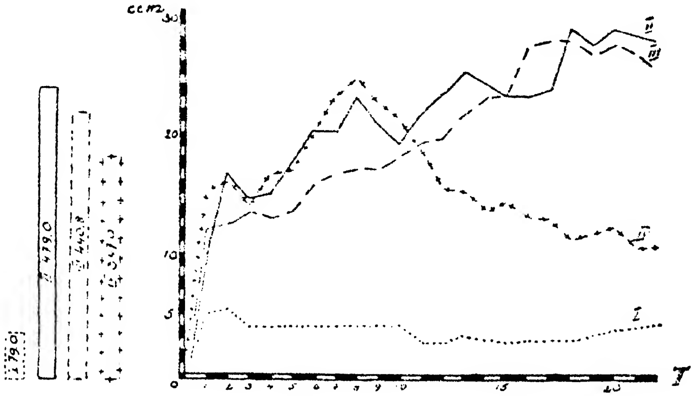

FIG. 86. — Experiments with marl loam from Kauzmünde

I. .... Distilled water.
II. ———————— 0.02 n $Ca(HCO_3)_2$ solution.
III. --------------- 0.012 n $CaSO_4$ solution.
IV. +++++ CO_2 solution about 0.5 = 1 g. per litre.
Left = Total quantity of filtrate in 22 days.

ginning. With water saturated with CO_2 a strong rise in permeability was here produced at the beginning followed by a correspondingly rapid fall from the 8th day.

(c) *Experiments with rubble marl loam, on which podsol soil is formed.* — The results are graphically represented in Illustration 87. The permeability of the rubble loam was on the whole higher than that of the first two band clays. There was a particularly steep rise of permeability at the beginning, under the influence of gypsum, and on the 5th day it reached the extent of 75 cm. per day. It is characteristic that in this experiment the permeability was not increased at all under the influence of the $Ca(HCO_3)_2$ solution. The experiment with $Ca(HCO_3)_2$ solution lasted 30 days, the others several months (The curve only shows the data for the first 60 days). After 36 days the soil in the little tube was stirred by a wire, which however had no special influence on the permeability, in fact pronounced reduction of permeability took place in the experiment with distilled water. From the 40th day onwards the $CaSO_4$ solution and distilled water still remaining in the little tube was replaced by a 0.01 n solution of

$Ca(OH)_2$. The permeability for $Ca(OH)_2$ solution after gypsum mounted very steeply and afterwards for four months, to the end of the experiment, kept constant at 55-50 cm. per day.

No influence of the Ca $(OH)_2$ solution, after distilled water, was observable in the course of 8 months. Not until then did the permeability rise somewhat, up to 6 ccm. per day, and not until after 16 months did it reach the height of 7 ccm. per day. At first the Ca $(OH)_2$

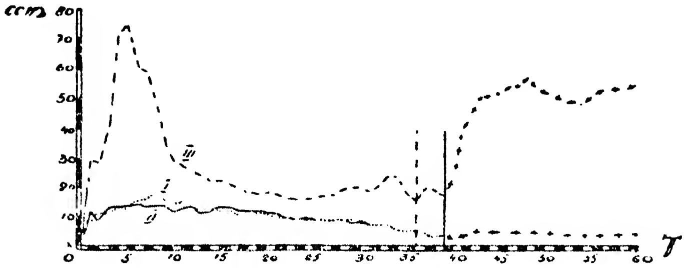

FIG. 87. — Experiments with rubble marl loam from Kursischi.

I. .... Distilled water.
II. ———————— 0.01 n $Ca(HCO_3)_2$ solution, interrupted after 31 days
III. ---------------- 0.012 n $CaSO_4$ solution.
-+-+-+-+- Continuation of the experiment with 0.01 n $Ca(OH)_2$ solution. The soil was stirred after 36 days.

was greatly absorbed by the marl loam, and the filtrate was not coloured with phenolphtalein until after 1 ½ months, when more than 200 ccm. $Ca(OH)_2$ solution had already passed through the layer of soil. Even after the $Ca(OH)_2$ had appeared in the filtrate, no alterations in permeability were observable, with the exception of the increase of the quantity of filtrate by 0.2 ccm. per day. Several special investigations were carried out regarding the influence of Ca $(HCO_3)_2$ on the rubble loam, from which it can be established that the permeability for these electrolytes is very small. Closer examination of the filtrates showed that they contain $NaHCO_3$, and in pretty high concentrations, at the beginning as much as 0.0035 n, after a month about 0.0015 n, and even 8 months still 0.0004 n. Experiments with other levels of the podsol soils gave much lower $NaHCO_3$ content in the filtrate. It may be assumed that the $NaHCO_3$ content also has an effect on the alterations of the $Ca(HCO_3)_2$ concentrations: in the filtrate through marl loam the latter, after 8 months, was only of 0.0018 normality, whereas the filtrates through other levels of Podsol soils showed concentrations of $Ca(HCO_3)_2$ of 0.0028-

0.0040 normality. As $NaHCO_3$ has the same anion as $Ca(HCO_3)_2$, it favoured the separation of $CaCO_3$. In the filtrates through the upper levels of the podsol soils the $NaHCO_3$ content was at the beginning only of 0.001 normality; after 8 months, however, in the filtrate through level A = 0.0003 N., through level B = 0.00004 N.

The filtration of 1 litre of $Ca(HCO_3)_2$ solution through a layer of marl loam 1 cm. deep produced the following quantities of K_2O and Na_2O per 100 g. soil:

	K_2O	Na_2O
	g.	g.
Band Clay from Renge	0.0096	0.0057
Stony marl loam from Kursischi	0.0038	0.0085

These data show that the rubble marl loam really contains greater quantities of Na_2O than the band clay from Renge, which, in the experiment conducted, may have had an effect on the permeability for the $Ca(HCO_3)_2$ solution. The influence of the gypsum solution on permeability must have been more favourable, because in this case no $NaHCO_3$ can have arisen as a product of chemical change, only Na_2SO_4.

Illustration 88 gives a graphic representation of the effect of the 0.01 n $Ca(OH)_2$ solution on the permeability of the rubble loam (Line C); although the experiment was continued for longer than 6 months, the permeability never rose particularly steep and high, and the greatest quantity of filtrate was only 15 ccm. per day. In the course of the experiment reduction and increase of permeability was observable several times. It is characteristic that the permeability was smallest at the beginning of the experiment, between the second and sixth days. The data obtained shows *that the permeability of the marl loams for distilled water, and also for the electrolytes examined, even in experiments of very long duration, does not increase, although great fluctuations are observable in the permeability. In all cases the permeability was raised by gypsum solutions, also the permeability for $Ca(OH_2)$ solution was much greater* (10 *times*) *after gypsum than after distilled water.* It must be pointed out that in all the experiments with marl loam the filtrates were perfectly clear, without any cloudiness. I tried to filter clay suspensions of the finest constituent parts of soil of acid podsol soils through marl loam, but in these cases also

the suspensions were already coagulated on the surface of the filtering bed, and did not even penetrate into the loam if the depth of the filtering bed was reduced to 2 cm. ; the suspensions filter almost as quickly as distilled water. As permeability was favourably influenced

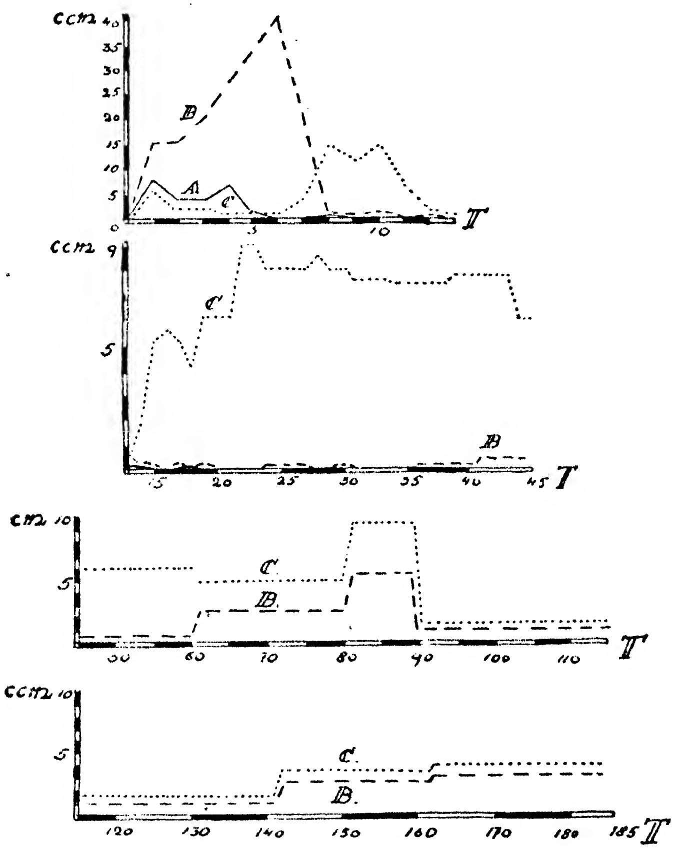

FIG. 88. — Permeability of the 3 levels of Podsol soil for 0.01 n $Ca(OH)_2$ solution in 185 days.

——— Level A : After 6 days the permeability is already almost completely interrupted, after 30 days completely interrupted, and does not rise again.

- - - - - Level B : The permeability is interrupted after 31 days, but afterwards rises again.

.... Level C : The permeability is not interrupted.

by gypsum solution, I made thorough investigations with gypsum and band clay from Renge. The following concentrations of gypsum were

examined : 0.012 n, 0.006 n, 0.003 n, 0.0015 n, 0.0007 n, and distilled water was used as control. At the beginning the permeability was much increased by the first four concentrations of gypsum, by the highest concentration up to as much as 30 cm. per day, but afterwards the permeability fell gradually and the differences were equalized. The permeability for distilled water after 40 days was 3 ccm. per day, for gypsum solutions, even the weakest, 6-10 cm. per day. After 40 days the gypsum solutions were replaced by 0.01 n, solutions of $Ca(OH)_2$ and the experiments continued for another 3 months. The permeability for Ca $(OH)_2$ was considerably increased in those samples through which Gypsum solutions of 0.0015-0.012 n were previously filter ed. The quantity of filtrate with $Ca(OH)_2$ in the sample after the weakest concentration of gypsum, 0.0007 n, was even smaller, although in the filtrate from this sample also traces of $Ca(OH)_2$ were noticeable after a month. Before the appearance of Ca $(OH)_2$ in the filtrate, great fluctuations of permeability were observed, from 1-6 ccm., per day and on 3 days the permeability was even completely interrupted, which points to the stopping up of the pores of the soil, and afterwards unstopping. At the close of the experiment the permeability for $Ca(OH)_2$, after the four stronger concentrations of gypsum, reached 14-27 cm. per day, after the lowest concentration 5 ccm., after distilled water 7 ccm. per day.

With band clays I and II (from Rénge and Kauzmünde) I made tests, after the gypsum and $(Ca(HCO_3)_2$ solutions, with distilled water. The tests lasted only 10 days, the permeability was considerably reduced.

Finally, tests were again made with the rubble loam with different concentrations of $NaHCO_3$.The results of these tests are not graphically represented, but they speak for themselves.

$NaHCO_3$ in the concentration of 0,05 n greatly reduced the permeability. The experiments with 0.001 n $NaHCO_3$ solution and distilled water were carried out twice with good corresponding results. All other concentrations of $NaHCO_3$ which were examined reduced the permeability, with the exception of the concentration of 0.00003 n, with which the permeability was almost equal to that for distilled water. It is hardly probable that such weak $NaHCO_3$ solutions as 0.0000001 n could so strongly influence the permeability; it may be that in this case other factors, remaining unknown, were decisive. The filtrates in all these experiments were also perfectly clear, with the exception of the concentrations of $NaHCO_3$ of 0.001 normality;

TABLE II. *Experiments with rubble loam with different concentrations of $NaHCO_3$.*

	Concentrations of $NaHCO_3$ in terms of N/1	Quantites of the filtrate in 20 days in ccm.
1	0.05	26
2	0.001	178
3	0.001	163
4	0.0003	171
5	0.0001	187
6	0.00003	246
7	0.00001	188
8	0.000003	160
9	0.000001	142
10	0.0000003	143
11	0.0000001	175
12	Distilled water	202
13	» »	280

in this experiment a very weak opalescence, and in time a very slight deposit were noticeable. This was the only case in the experiments with marl loams.

In my earlier treatise on the coagulation of clay suspensions I have already given expression to the assumption that marl loam, under the influence of $Ca(HCO_3)_2$ solutions, develops $NaHCO_3$. In the investigation submitted I have not indeed been able to establish the pronounced retarding influence on coagulation of the marl loam, still it may be assumed that in the filtration experiments the $NaHCO_3$ raises the degree of dispersiveness and hinders filtration. This may be concluded also from the high $NaHCO_3$ contents of the filtrates on filtration of the $Ca(HCO_3)$ solution.

I have already established that the permeability of marl loams is raised more strongly by gypsum solutions than by $Ca(HCO_3)_2$ solutions, especially those marl loams on which Podsol soil has already developed, and consequently larger $Na^{\cdot}$ and $K^{\cdot}$ ions from the transformed upper level have trickled through the soil. With the absorbed $Na^{\cdot}$ and $K^{\cdot}$ ions gypsum gives no carbonic acid but sulphates, whose influence is different. In time, however, the permeability of the gypsum solutions is also reduced ; it is conceivable that in this case those $Na^{\cdot}$ and $K^{\cdot}$ ions operate which arise on the hydrolysis of the silicate. That this hydrolysis takes place in experiments extending over several weeks can be seen from the fact that hydrocarbonates can be found in this case in the gypsum solution which filters off, even if the filtering soils contain no $CaCO_3$.

Experiments with loams free from $CaCO_3$.

For the experiment level B of the podsol soil was used, the same from which the clay suspensions were obtained with which the experiments regarding coagulation were carried out. The sample of soil was taken from the same place in the neighbourhood of Kursischi, from which also the rubble loam was taken, and was found directly over the latter. The content of CaO soluble in hot hydrochloric acid is pretty high, namely, 0.93 %, though this loam after a few hours shows acid reaction on litmus paper. The explanation is to be sought in the very fine grained mechanical composition. The mechanical analysis was carried out by the method of Prof. GEDROIZ, in pursuance of which the the loam was first treated 15 times with normal NaCl solution. The mechanical composition was as follows :

TABLE III. — *Mechanical composition of the sample of soil.*

Size of grain in mm.	Time of depositing from water 10 cm. deep.	Contents of little grains in %
1 — 0.05	1 minute	35.64
0.05 — 0.01	10 minutes	7.56
0.01 — 0.005	6 hours	12.12
0.005 — 0.001	24 »	6.05
0.001 — 0.00022	3 weeks	11.78
below — 0.00022	—	23.03

In this case the sample of soil was not heated. In the analyses with which samples of soil of the same loam were previously prepared by heating with NH_3, I only obtained 24.36 % of grains which were not deposited in 24 hours ; with the kind of preparation now used this amount is raised to 35.41 %.

It must be mentioned as a characteristic of the loam that it is fairly rich in K_2O and Na_2O, as is shown by the following data :

	K_2O	Na_2O
I Dissolves in hot 10 % HCl	0.555 %	0.05 %
II » in cold 0.015 n. HCl	0.015 %	0.019 %
III » out of 100 g. soil in 1 litre 0.02 n $Ca(HCO_3)_2$!	0.0042 g.	0.0043 g.

This loam proved particularly sensitive in the experiments for permeability. The results of the examinations are shown graphically in Illustration 89.

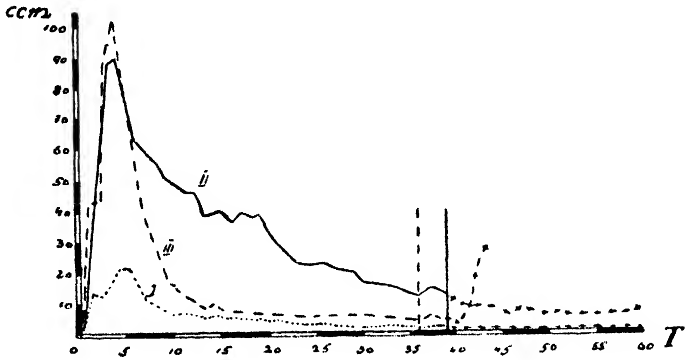

FIG. 89. — Experiments with level B of the Podsol soil from Kursischi.

I. .... Distilled water.
II. ———— 0.01 n $Ca(HCO_3)_2$ solution.
III. - - - - - - 0.012 n $CaSO_4$ solution.
+ + + + + Continuation of the experiment with 0.01 n $Ca(OH)_2$ solu ion. Stirring up of the sample of soil on the 36tht day.

Distilled water filters pretty well at first, but the quantity of filtrate already reaches its maximum (22 cm. per day) on the 5th day, and afterwards falls fairly fast after 30 days almost reaching 0. The breaking up of the sample of soil, which was done between the 36th and 39th days, also had no effect. After 40 days the experiment was interrupted, and instead of distilled water 0.01 n $Ca(OH)_2$ solution was used. This solution also had no influence, the permeability was not raised. This loam proved much more sensitive to $Ca(HCO_3)_2$ and $CaSO_4$ solutions. The permeability was greatest for gypsum solutions and on the 4th day reached the quantity of 102 ccm. per day, which must be described as a very great amount. The permeabil-bility fell very fast in the following days, however, and the breaking up of the soil then carried out had no effect. After replacing the Gypsum solution with $Ca(OH)_2$ the permeability again rose rapidly. The permeability of the loam was also much increased by $Ca(HCO_3)_2$ solution, and with this did not become less so quickly as in the experiments with gypsum solution.

The influence of various stronger concentrations of $Ca(HCO_3)_2$ solution on the permeability of the loam were also investigated. Illustration 90 shows the total quantity of filtrate in 21 days. Each concentration was examined in two parallel tests, and results were obtained which corresponded pretty well with each other. After 21 days, instead of $Ca(HCO_3)_2$ solution, a 0.01 n solution of $Ca(OH)_2$ was used. With this the permeability in all samples was very much

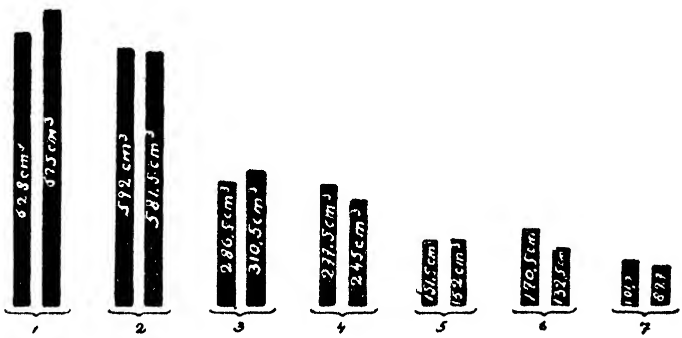

FIG. 90. — Level B of the Podsol soil. Quantities of filtrate in 21 days with distilled water and different concentrations of the $Ca(HCO_3)_2$ solution.

No. 1 = 0.02 n, No. 2 = 0.01 n, No. 3 = 0.005 n No. 4 = 0.0025 n, No. 5 = 0.0012 n, No. 6 = 0.0006 n, No. 7 = distilled water.

reduced, and only after several months did it rise again in the first four tubes to 10-20 ccm. per day. The experiments were continued for 15 months. The general impression at the conclusion of the experiment was as follows: The permeability of the samples of soil, after previous filtration of $Ca(HCO_3)_2$ solutions of 0.02 n, 0.01 n and 0.0025 n, amounted to 7 - 15 ccm. per day, with which similar variations were also observable in parallel examinations. The permeability for $Ca(OH)_2$ of the remaining samples of soil, after previous filtration of the remaining $Ca(HCO_3)_2$ solutions of 0.003, 0.0012 and 0.0006 normal and also of the distilled water, was almost completely eliminated becoming not greater than 0.5 ccm. per day.

Direct examination of the 0.01 n $Ca(OH)_2$ solution (illustration 88) showed that the permeability rose pretty quickly, on the 4th day attained 41 ccm. per day, but already on the 8th. day stopped almost completely, not to rise again until after 40 days. At the conclusion of the experiment the quantity of filtrate amounted to 3 ccm.per day.

A 0.05 n and 0.001 n solution of $NaHCO_3$ were also examined. In 20 days the total quantity of filtrate amounted to:

0.05 n $NaHCO_3$	42 ccm.
0.001 n »	123 ccm.
Distilled water	117 ccm.

The filtrates after distilled water and 0.001 n $NaHCO_3$ were not quite clear, but opalescent, but with the 0.05 n $NaHCO_3$ solution no solid constituent parts were washed out of the soil. It is interesting to note that the weaker concentrations of $NaHCO_3$ exerted no retarding effect on the filtration.

The qualities of the loam examined are very bad in nature, it is therefore described as "sticky" and "builder's" loam. Through the level of the loam mentioned, on the development of podsol soil, the washed out levels ($A_1 + A_2$) of the rubble loam are eliminated. The permeability of this loam is very greatly influenced by drying, as also by deeply penetrating freezing of the damp soil; if, however, the soil has been very damp for a long time, the permeability will be greatly reduced. The experiment carried out, which shows the increase of permeability with the $Ca(OH)_2$ solution after gypsum, leads to the assumption that the qualities of the loam mentioned can be improved by gypsum solutions. It is possible that the contents of absorbed $K^{\cdot}$ and $Na^{\cdot}$ ions in the loam are reduced by gypsum solutions.

Experiments with humus levels.

In these experiments great variety could always be observed after the reaction of the humus levels. The permeability of neutral samples of soil differs greatly from that of acid samples.

For the first experiment a neutral soil from the neighbourhood of Sigulda was used. This soil contained 12.2 % of particles finer than 0.01 mm., 3.2 % humus, and 0.86 % $CaCO_3$. The results of the experiments are represented in Illustration 91. On the first day of the experiment the permeability for distilled water reached 91 ccm. per day, but then became fairly quickly and considerably reduced, and amounted to only 9 ccm. per day on the 18th day. From the 18th to the 25th day 0.12 n gypsum solution was used instead of

distilled water, but this did not exert any special influence; later, however, a 0.01 n $Ca(OH)_2$ solution was used, by which the permeability was increased in the next 7 days to 80 ccm. per day. From the 32nd. day onwards distilled water was again used, and consequently the permeability was again quickly reduced.

More thorough investigations were made with two other samples of soil; the 1st similar to the Rendzine soil is neutral, from the neighbourhood of Kauzmünde, containing 4.34 % humus and 0.43 % $CaCO_3$; the 2nd soil is typical Podsol soil, of a similar kind to that whose clay suspensions were investigated in an earlier work. It contains 2.52 % of organic matter, which, however, is but slightly decomposed and cannot really be designated as humus. Lime-marl, reckoned as $CaCO_3$, amounts to 0.25 %. The soil of course contains no $CaCO_3$. The quantity of CaO soluble in hot HCl amounts to 0.089 %. The mechanical composition of the soil can be seen from the following data (see Table IV page 571.

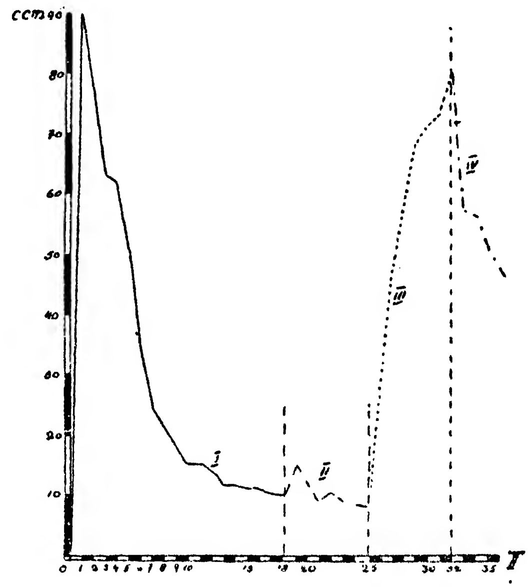

FIG. 91. — Permeability of level A of the neutral arable soil from Sigulda.

I. ———— Distilled water.
II. -------- Continuation of the experiment 0.012 n $CaSO_4$ solution.
III. .... Continuation of the experiment with 0.01 n $Ca(OH)_2$ solution.
IV. —.—.—.—. Continuation of the experiment with distilled water.

In comparison with the above mentioned marl loam, both the soils mentioned have much coarser composition. Both soils were prepared for the mechanical analysis by treating the sample of soil 15 times with NaCl n solution. This treatment was quite sufficient for the acid soil, but in the neutral soil the constituent parts which

TABLE IV. — *Mechanical composition of both samples of soil.*

Size of grain in mm.	Time of depositing	Contents in %	
		Neutral soil	Acid soil
1 — 0.05	1 minute	36.8	41.38
0.05 — 0.01	10 minutes	33.30	18.18
0.01 — 0.005	6 hours	18.88	23.76
0.005 — 0.001	24 »	3.38	6.26
0.001 — 0.00022	3 weeks	2.54	6.35
below 0.00022	—	2.31	3.30

were not deposited in 6 hours still contained fairly large quantities of coagulated particles and organic matter ; the mechanical composition of this soil must therefore be fine grained. It is also characteristic that on washing out with salt solution, great quantities of organic matter from the neutral soil went into solution, but very little from the acid soil. The colour of the soils was also dissimilar : that of the neutral soil almost black, of the acid bright grey. Also the contents of Na_2O and K_2O in the podsol soil were fixed :

	K_2O	Na_2O
Dissolves in hot HCl	0.165 %	0.021 %
» in cold 0.05 n HCl	0.010 %	0.013 %
» out of 100 g soil per litre $Ca(HCO_3)_2$. . .	0.0026 g!	0.0042 g.

The results of the examination of the neutral soil with distilled water are represented in Illustration 92.

The permeability at the beginning increased quickly, on the 4th day it already reached almost 200 ccm. per day, which can be described as the maximum permeability for water in my experiments with loamy soil. Afterwards the permeability fell quickly and by great bounds, and after 183 days it amounted to only about 0.2 ccm. per day ; after another month no more filtration took place ; after 3 months however, therefore 10 months from the commencement of the experiment, the lower part of the soil in the test tube began to dry up, although water was present for the whole time in the tube and also in the round flask.

The results of the examination of the neutral soil with 0.01 n $Ca(OH)_2$ solution are represented in Illustration 93. The permeability for this solution was at the beginning even greater than 200 ccm. per day; afterwards it was indeed reduced, but never fell below 15 ccm.

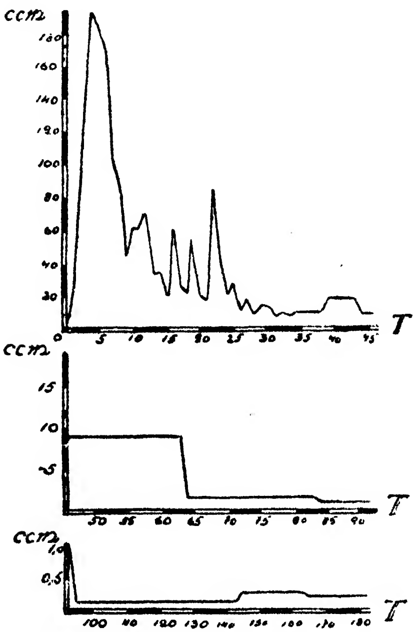

FIG. 92. — Permeability of the upper level of neutral arable soil from Kauzmünde in 183 days. On the continuation of the experiment the permeability was completely interrupted.

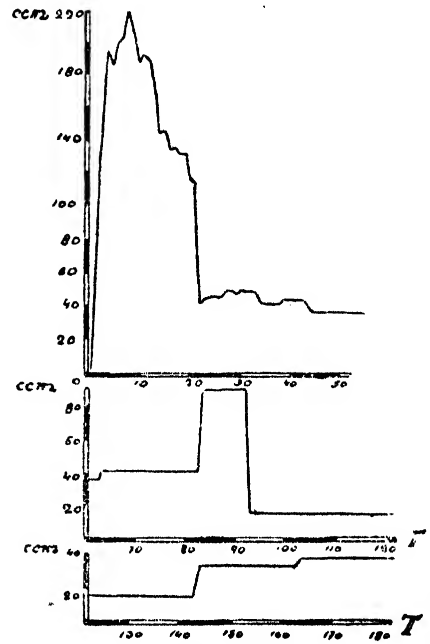

FIG. 93. — Permeability of the upper level of the neutral arable soil from Kauzmünde for $Ca(OH)_2$ solution.

per day. After 6 months, at the conclusion of the experiment, it amounted to almost 40 ccm. per day.

We see quite another picture on the examination of the acid Podsol soil. The results of these examinations are represented in Illustration 94.

Although the soil has no great quantities of the finest constituent parts, the permeability for distilled water is very low. The permeability was raised by $Ca(HCO_3)_2$ and $CaSO_4$ solutions, although relatively little, the effect of the $Ca(HCO_3)_2$ solution being the greater. Here also the breaking up of the soil did not help. From the 39th day onwards 0.01 n $Ca(OH)_2$ solution was filtered through all the test

tubes. The permeability for this salt also was very slight. The filtration of the $Ca(OH)_2$ solution was still continued for 4 months, with which at the close of the experiment the permeability in all the tubes was almost alike, about 1 ccm. per day. During the whole period of the experiment the filtrate gave no colouring with phenolphtalein, the $Ca(OH)_2$ was therefore absorbed the whole time from the soil through which the solution trickled. The absorption must

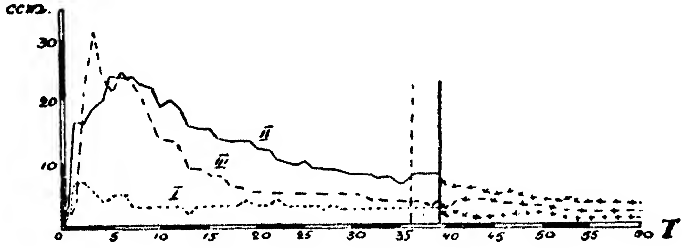

FIG. 94. — Experiments with level A of the podsol soil.

I. .... Distilled water.
II. ————— 0.02 n $Ca(HCO_3)_2$ solution.
III. --------------- 0.01 n $CaSO_4$ solution.
-+-+-+-+-+ Continuation of the experiment with 0.01 n $Ca(OH)_2$ solution.

probably in this case also be considered as the main reason why the permeability for $Ca(OH)_2$ was not greater under the conditions of the test.

Illustration 88 shows us the results of the comparison when from the beginning onwards $Ca(OH)_2$ solution is filtered through acid soil. The permeability indeed is increased at the beginning, but does not exceed 7 ccm. per day ; after 6 days, however, scarcely any filtration takes place.

Only 2 concentrations of $NaHCO_3$ — 0.05 n and 0.001 n — were examined. The permeability for these solutions, in comparison with distilled water, showed no great difference ; in 20 days the following quantities of the solution passed through :

0.05 n $NaHCO_3$	= 81 ccm.
0.001 n $NaHCO_3$	= 76 ccm.
distilled water	= 95 ccm.

In all experiments with distilled water, $NaHCO_3$, Ca $(OH)_2$ (the latter was completely absorbed by the soil) considerable washing out of the finest constituent parts of the soil was observable. The filtrate

was cloudy, and a portion of the cloudiness deposited itself in the flask as fine sand. With this a characteristic layer developed in the test tube which was very easily seen. Such layers occur also in the loam (level B) in the experiments with distilled water, and in the clay soil, but never in the marl loams. Regarding the dried experimental soil which exhibited layers, I was not successful in dividing this into individual layers, as I had been with the band clays. Such stratification can also be observed in the upper levels of the Podsol soils, which are much washed. The formation of the layer is regarded by Prof. K. GLINKA (3) as the result of a high degree of dispersiveness of the soil. The commencement of the formation of the layers can already be seen after a few days in the experiments with distilled water, after a few weeks, however, the layers are already very well formed, the layers at the lower end of the tube being formed the best, but in the experiments with $NaHCO_3$ also in the upper part. In all experiments with acid soils, especially with levels A_1 and A_2 of the podsol and clay soils, strong washing out of the $Fe(OH)_3$ could be observed, whereas in the experiments with neutral soils and soils containing $CaCO_3$ no notable washing out of $Fe(OH)_3$ could be observed.

Experiments with gley loams.

As "gley" loams are described the upper levels of such more or less loamy soils as are greatly transformed under the influence of excessive moisture and organic matter. The loam acquires a blue grey colour, is very sticky when in a damp condition, and very hard in a dry condition. Pits dug in gley loam, and open ditches, soon fill up, because the sides soon fall in. The content of clay particles in the gley loam is very varied, from 10-70 % and more. The permeability for water is very small, often even drains act badly in gley loam, for the water forces its way to them with difficulty. The upper levels of the gley loam contain no $CaCO_3$, they have even a strongly acid reaction; at a relatively small depth, however, we find marl loam but it has very bad physical qualities. The gley loams contain small quantities of organic matters, the upper level, however, contains large quantities of the same, which are acid.

We find typically formed gley loam on making a vertical cutting of the earth where the subsoil is loamy; the width of the gley loam seldom exceeds 20-50 cm.

The experiments were carried out with 2 gley loams, the first

from the neighbourhood of Kasdanga, the second from Sigulda. The mechanical composition of these gley loams is as follows:

TABLE V. — *Mechanical composition of the two samples of gley loam.*

Size of grain in mm.	Time of depositing	Contents in %	
		I. Kasdanga	II. Sigulda
1 — 0.05	1 minute	4.14	24.70
0.05 — 0.01	10 minutes	14.34	30.60
0.01 — 0.005	6 hours	28.60	22.50
0.005 — 0.001	24 »	8.53	3.07
0.001 — 0.00022	3 weeks	17.82	0.54
below 0.00022	—	26.07	0.78

We see, therefore, that the first gley loam is especially rich in the finest constituent parts, even richer than the above mentioned level B of the podsol soil. The content of finest constituent parts of the second loam is lower, but greater than that of the level of the podsol soil. Both loams react on litmus paper in a pronouncedly acid manner. In my earlier experiments on the influence of electrolytes on the clay suspensions of these soils it was established that these clay suspensions are not very sensitive to electrolytes: In order to produce coagulation, very strong concentrations of electrolytes are necessary. By the presence of very small quantities of $NaHCO_3$ the influence of the electrolytes is further reduced. The contents of K_2O and Na_2O soluble in hot 10 % HCl were fairly high:

	K_2O	Na_2O
	%	%
I. Clay soil (Kasdanga)	0.505	0.105
II. » » (Sigulda)	0.240	0.065

Also in cold 0.05 n HCl fairly large quantities of the oxide mentioned were dissolved:

	K_2O	Na_2O
	%	%
I. Clay soil (Kasdanga)	0.019	0.032
II. » » (Sigulda)	0.012	0.012

By the filtration of 1 litre 0.02 n $Ca(HCO_3)_2$ through 100 g. soil were dissolved:

	K_2O	Na_2O
	g.	g.
I. Clay soil (Kasdanga)	0.0108	0.0175
II. » » (Sigulda)	0.0020	0.0016

From the data quoted it is to be concluded that the first gley soil, with filtration of $Ca(HCO_3)_2$, will give much greater quantities of $NaHCO_3$ in the filtrate than will the second, and at the same time filtration through the first soil will also proceed more slowly; the experiment has confirmed this.

In Illustration 95 the results of a few experiments with the second (II) gley soil during the first 23 days are graphically represented.

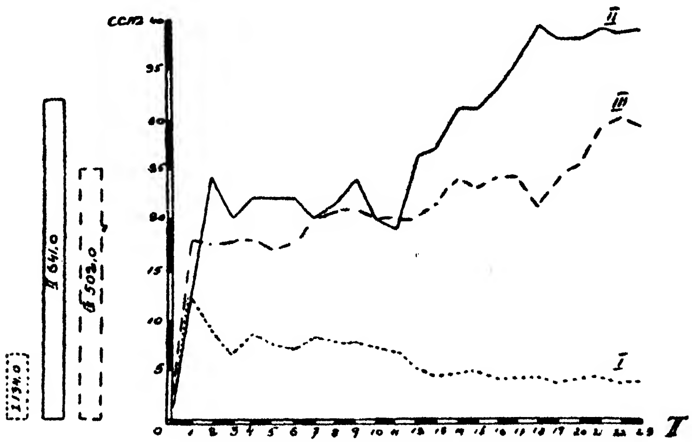

FIG. 95. — Experiments with gley loam (II) from Sigulda.

I. .... Distilled water.
II. ————— 0.02 n $Ca(HCO_3)_2$ solution.
III. -------------- 0.012 n $CaSO_4$ solution.
Left = Total quantity of the filtrate.

The permeability for distilled water was at the beginning pretty good, but after 23 days it fell to 4 ccm. per day. In the further course of the experiment this quantity became smaller, and after 6 months it amounted to only about, 0.3 ccm. per day.

The permeability for $CaSO_4$ and particularly for $Ca(HCO_3)_2$ was much greater, but if, after these salt solutions, the experiment

was continued with distilled water, then the permeability was reduced very gradually, especially after $Ca(HCO_3)_2$, so, for example, for the next 11 days the quantity of filtrate after $Ca(HCO_3)_2$ amounted to 259 ccm., and after $CaSO_4$ to 90 ccm. The permeability of the clay soil was considerably increased by $Ca(HCO_3)_2$. It is to be assumed that in this case the $Ca^{\cdot\cdot}$ ion had operated which was absorbed by the soil and had thereby altered the qualities of the soil. This conclusion is confirmed by the further series of experiments, the results of which are represented in Illustration 96. In this series of experiments the gley soil from Sigulda (II) was used, from wich the lime-marl was removed (Line 1). The gley loam was several times throughly mixed with $Ca(HCO_3)_2$ solution, the solution poured off every time, and the gley loam afterwards dried and pulverized anew. By this treatment the quantity of absorbed K and Na was reduced, which in this loam generally is not very great. The original, unchanged gley loam from Sigulda (line 2) serves for comparison. For the first 3 days distilled water was filtered. In the sample in which the lime-marl was removed (L 1) this filtration proceeded better. After 3 days, instead of distilled water, gypsum solution was used. The filtration of this solution also proceeded better through the first loam, although the difference was not great. From the 16th day onwards, instead of gypsum solution, 0.02 n $Ca(HCO_3)_2$ solution was used. With this solution the difference was very great: the permeability of the first gley soil increased very quickly, the permeability of the second soil acid decreased strongly at first, then increased again, and not until about two months after starting the experiment did the differences equalize. Three months

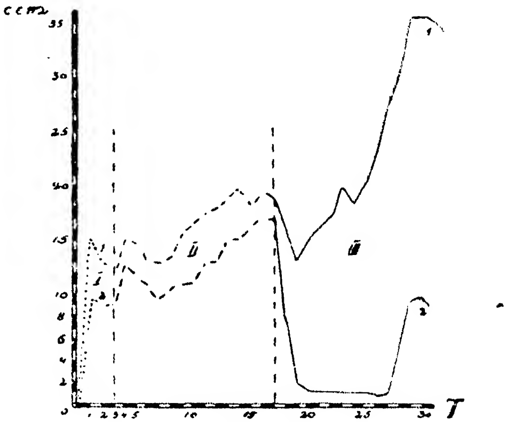

FIG. 96. — Experiments with gley loam from Sigulda.

No. 1 = lime-marl removed, No. 2 = natural clay loam.

I. .... Distilled water.
II. -------------- Continuation of the experiment with $CaSO_4$ solution.
III. ———— Continuation of the experiment with $Ca(HCO_3)_2$ solution.

after starting the experiment a 0.01 n $Ca(OH)_2$ solution was used instead of $Ca(HCO_3)_2$. With this solution the quantities of filtrate fluctuated very little during the whole course of the experiment, the permeability for the first gley soil amounted to 15-20 ccm. per day, for the second (natural) 8-12 ccm., with which the greatest quantities were obtained at the end of the experiment, after 7 months.

In Illustration 97 the results of the experiment with both natural

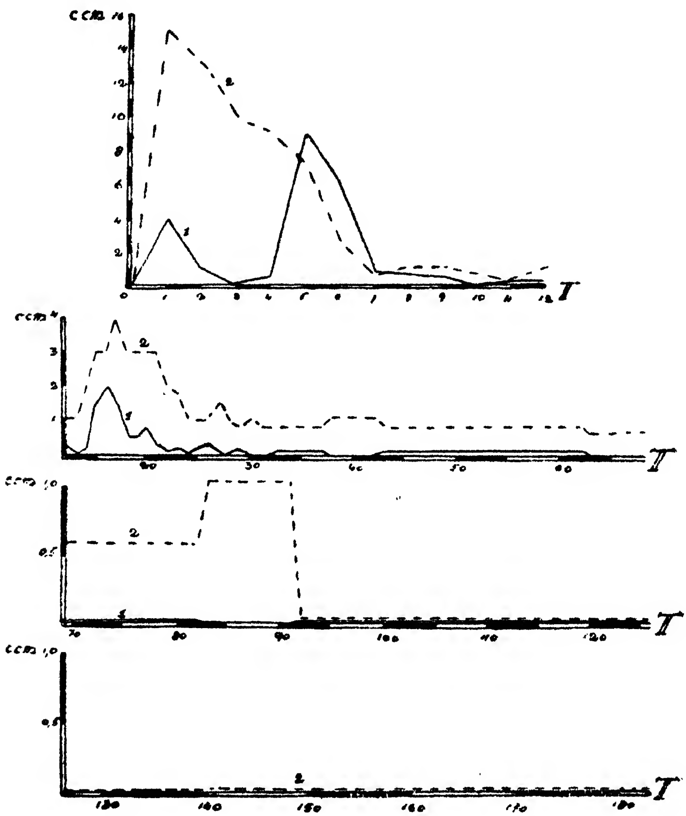

FIG. 97. — Permeability of the Gley soils for $Ca(OH)_2$ solution.

I. ———— Gley loam from Kasdanga ; the permeability stops completely after 36 days.

II. ------------ Gley loam from Sigulda ; after 91 days the permeability is very small.

clay soils are put together, with which from the beginning ($Ca(OH)_2$ solution was used. The permeability did not increase greatly in either

of the soils examined, not even at the beginning: the highest quantity of filtrate in the clay from Kasdanga amounted to 9 ccm. (5th day), in the clay from Sigulda 15 ccm. (1st day). Afterwards the permeability decreased, and in the sample from Kasdanga filtration ceased altogether after 60 days; in the sample from Sigulda the permeability after 90 days amounted to about 0.2 ccm. per day. There was no $Ca(OH)_2$ present in the filtrate, it being completely absorbed by the soil.

With the II. Gley soil from Sigulda thorough examinations were carried out with various concentrations of $NaHCO_3$. The gley soil showed itself very sensitive to even very weak concentrations of $NaHCO_3$: the permeability sank greatly, especially at the beginning, and the finest constituent parts of the soil showed in the filtrate. In a few cases the permeability afterwards increased again, which can be seen from the following data:

TABLE VI. — *Gley loam from Sigulda, quantities of filtrate in ccm.*

	The first 20 days	The next 6 days
1. Distilled water	131	0.8
2. $NaHCO_3$ 0.001 n	55	8.5
3. » 0.003 n	59	10.0
4. » 0.0001 n	79	29.0
5. » 0.00003 n	20	0.4
6. » 0.00001 n	50	12.5

Experiments were also carried out with higher concentrations of $NaHCO_3$. With these it was established that by 0.1 n $NaHCO_3$ solutions very great quantities of organic matter and $Fe(OH)_3$ were washed out; the filtrate was dark brown. With lower concentrations of 0.01 n much less organic matter is present in the filtrate. With these, however, mineral matters are strongly washed out, not only amorphous and colloidal, but also finely crystallized. The quantities of filtrate are very small. With the gley soil II from Sigulda experiments were carried out regarding the influence of the structure of the soil on permeability, for which particles of soil from 1-2 mm. diameter were taken from the pulverized soil, but the finer constituent parts were granulated. With this the permeability increased very strongly, but the parallel determinations gave very varying results; the variations were much greater than in the corresponding experiments with gley loam pulverized and granulated through a 1 mm. sieve. The

particles dissolved very soon, especially under the influence of the distilled water and the $NaHCO_3$ solution. In 15 days the following quantities of filtrate were obtained :

TABLE VII. — *Gley loam from Sigulda. Soil particles* 1-2 *mm. diameter.*

	I.	II.
	ccm.	ccm.
1. Distilled wafer	343	515
2. 0.01 n $Ca(OH)_2$	1220	1990
3. 0.01 n $CaSO_4$	719	1410
4. 0.00003 n $NaHCO_3$	118	57

The greatest quantity of filtrate per day, amounting to 192 ccm. was obtained with $Ca(OH)_2$ solution. It is of interest that in this experiment also the permeability was greatly reduced by the very weak concentration of $NaHCO_3$ of 0.00003 n. In proceeding further, the filtration ceased completely. Experiments were also carried out with low concentrations of $NaHCO_3$, with which a distinctly retarding influence was exerted by a 0.00001 n $NaHCO_3$ solution ; the influence of still smaller concentrations, however, was no clearer.

The results of the experiment with the clay loam from Kasdanga are represented in Illustration 98. The permeability of this loam

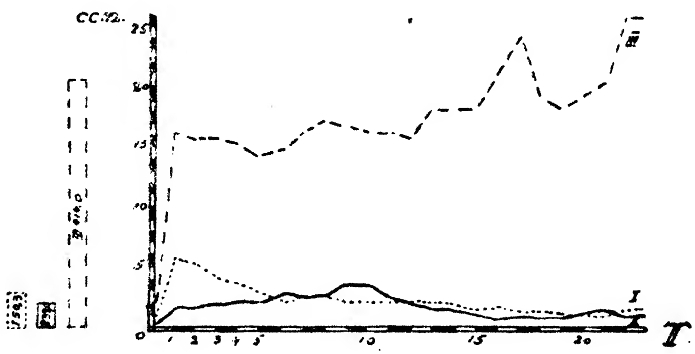

FIG. 98. — Experiments with Gley loam from Kasdanga.

I. .... Distilled water.
II. ———————— 0.02 n $Ca(HCO_3)_2$ solution.
III. --------------- 0.12 n $CaSO_4$ solution.
Left = Total quantities of filtrate.

was greatly reduced by $Ca(HCO_3)_3$ solutions. The filtration of the same proceeded even more slowly than that of the distilled water. In

the filtrate of these solutions direct $NaHCO_3$ and even Na_2CO_3 could be determined, which can also be assumed as the main reason of the slow filtration. The permeability for gypsum solution was pretty good, but after a longer time — several months — this fell also here to 4-6 ccm. per day. With distilled water on the first day of the experiment there was only obtained 5.5 ccm. of filtrate ; the permeability was afterwards lower, after about a month it amounted to only 1 ccm. per day, and after 2 months the filtration ceased completely.

On account of these qualities of the gley loam from Kasdanga, and also on account of its high content of the finest soil particles, and its great quantities of absorbed $Na^{\bullet}$ ions, I have again examined the permeability of the loams mentioned for solutions which at the same time contain $CaSO_4$ and $Ca(HCO_3)_2$ in varying proportions to each other. As basic solutions 0.012 n $CaSO_4$ and 0.02 n $Ca(HCO_3)_2$ were used. After 40 days the following quantities of filtrate were obtained :

TABLE VIII. — *Permeability of the gley loam from Kasdanga.*

Used for filtration	Quantity of filtrate in 40 days in ccm.
1. 0.024 n $CaSO_4$	299
2. 0.012 n »	310
3. 90 % 0.012 n $CaSO_4$ + 10 % 0.02 n Ca $(HCO_3)_2$	500.4
4. 70 % » » + 30 % »	298
5. 50 % » » + 50 % »	839.5
6. 30 % » » + 70 % »	528
7. 10 % » » + 90 % »	234
8. 0.02 n Ca $(HCO_3)_2$	219.7
9. 0.01 n »	4[illegible]
10. 0.005 n »	[illegible]4.9

The permeability was much increased if the gypsum solution at the same time contained $Ca(HCO_3)_2$, although the permeability for 0.01 n $Ca(HCO_3)_2$ solution was very small. After 40 days all solutions were replaced by 0.01 n Ca $(OH)_2$ solutions, and the experiments continued. On the next day $Ca(OH)_2$ could only be indicated in the filtrate in tube No. 3, through which previously 90 % gypsum and 10 % $Ca(HCO_3)_2$ were filtered ; the quantity of filtrate here rose quickly to 40 ccm. per day and kept at this height for about 5 months running. After 5 months distilled water was used instead of lime

water, and with this the permeability was again reduced. I still continued this experiment for another year, but even at the end of the experiment the permeability was fairly strong, the quantity of filtrate fluctuating between 8-9 ccm. per day.

The experiments with all the other test tubes of the same series were also continued for 18 months, but $Ca(OH)_2$ appeared in the filtrate only in 2 other tubes: in tube No. 2 after 45 days from the beginning of the $Ca(OH)_2$ filtration, and in tube No. 5 after 3 months, but the permeability was here only slightly increased. The permeability of the last 3 tubes was very low, and in tube No. 9, through which 0.01 n $Ca(HCO_3)_2$ solution was previously filtered, the filtration very quickly ceased completely.

The last series of experiments show that the permeability of a few gley loams can be strongly raised by solutions which contain at the same time $CaSO_4$ and $Ca(HCO_3)_2$. The influence of the gypsum in hindering the formation of $NaHCO_3$ and in helping the washing ont of the absorbed $Na^{\bullet}$ ions was here very obvious, whereas by the $Ca(HCO_3)_2$ the content of $H^{\bullet}$ ions in the soil that is, the acidity of the soil is reduced.

In the district of Hasenpoth, whence the last sample of gley loam (Kasdanga) comes, the liming of the soil with meadow or orginal lime has already been known for a long time, and has given good results pretty quickly. The results have only been rather indefinite with gley soils, which here showed an acid reaction to litmus paper. In these cases the application of gypsum is necessary for the improvement of the qualities of the soil, as is shown by the experiments carried out.

Experiments with n (5.85 %) *NaCl solution.*

The results of these experiments differ very much from the others, it is therefore fitting to consider them separately. The experiments were carried out with the six most important samples of soil which were also used in the earlier experiments. The concentration of NaCl used was strong, 1.0 normality, which in all the soils examined produced coagulation of the finest constituent parts of the soil. The earlier experiments showed that by 0.2 n salt solution the clay suspensions of the acid soils were coagulated, whereas coagulation of the clay suspensions of the marl loam was already brought about by 0.04 n solution.

Illustration 99 shows the results of the experiments with the three main levels of the Podsol soil. The permeability for NaCl in solution was smallest in the marl loam, followed by level A ; level B has the greatest permeability, however, although even here in the first few days 15-19 cm. per day was not exceeded, which amounts are much smaller than those of the experiments with $Ca(HCO_3)_2$ and $CaSO_4$ solutions. From the 8th day onwards we see strong and steep reduction of the permeability ; the line resembles that obtained by D. J. HISSINK 4.) in his experiments with distilled water after previous filtration of the common salt. After 8 days, in my experiments, I loosened the soil in the test tubes with copper wire about 1 mm. thick, but continued the filtration of the normal NaCl solution. Such loosening of the soil had no injurious effect on the filtration of the $Ca(HCO_3)_2$, $CaSO_4$ solutions and the distilled water in the above experiments, but with NaCl the influenc e was very great. From this it is to be seen that common salt solutions, even in strong concentrations, cause alterations in the qualities of the soil. It is characteristic that after the loosening of the soil the permeability of level A was the greatest, then followed that of level B, and it fell greatly in the marl loam of level C, which here also was not helped by the high contents of $CaCO_3$. Here the filtrate through the marl loam was very alkaline.

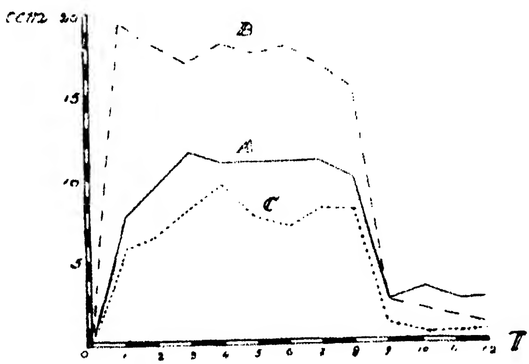

FIG. 99. — Experiments with n NaCl = solution with levels A, B and C of the Podsol soil (C = rubble loam).

It may be taken that in this experiment the circumstance of the absorbed soil cations towards Na and hydrolytic decomposition is of the greatest importance. It must be taken into consideration that the reaction of the first two levels is acid, and here, under the influence of NaCl, small quantities of HCl appear. If other salts are also present in the solution, the HCl, even in very small concentrations, assists coagulation. According to GEDROIZ (5) H_2SO_4 has a coagulat-

ing effect even in concentrations of 0.000075 normality. The action of common salt on marl loams might be quite otherwise. As an electrolyte with different anion and cation, NaCl has here raised the electrolysis of the $CaCO_3$. In the solution might form certain quantities of $OH^{\cdot}$ ions, perhaps even NaOH, whose influence on the increase of dispersiveness is particularly great. The quantity of filtrate through marl loam only amounted to 60 ccm. in the first 8 days; it is difficult to suppose that NaCl could exchange even greater quantities of $Ca^{\cdot\cdot}$ for $Na^{\cdot}$.

The results of simultaneous experiments with gley loams are represented in Illustration 100. It must be pointed out here that the permeability of the very acid I. gley loam from Kasdanga, which is rich in the finest constituent parts, altered very little after 8 days from the loosening of the soil ; on the other hand the permeability of the II. gley loam from Sigulda was already reduced a day before the loosening, to fall still more strongly after the loosening. The permeability of the neutral, upper level from Kauzmünde was already reduced after 7 days. The reduction was especially great, however, after the loosening of the soil (8th day). The experiments carried out show that in comparison with very weak $CaSO_4$ and $Ca(HCO_3)_2$ concentrations, the common salt as such greatly reduced the permeability, the reduction being much greater, and proceeding more quickly in soils carrying $CaCO_3$ than in acid soils. As under the influence of the NaCl the content of absorbed $Na^{\cdot}$ ion is greater, it is obvious that in the further course of the experiment, and particularly on filtration of $Ca(HCO_3)_2$ the results can only be relative. We have already seen that in the experiment with gley loam from Kasdanga, which, with the filtration of $Ca(HCO_3)_2$, from 100 g. soil gave

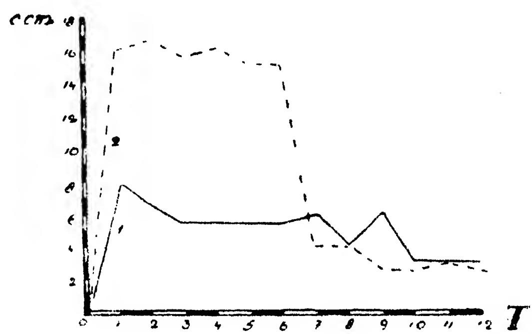

FIG. 100. — Experiments with n NaCl solution in Gley loams.

1. ———————— Gley loam from Kasdanga.
2. ------------------ Gley loam from Sigulda.

to the filtrate 0.0108 g. Na_2O. In the filtration experiments this gley loam with $Ca(HCO_3)_2$ gave smaller quantities of filtrate than with distilled water.

VII. — General conclusions.

The results obtained can be summarized briefly as follows:

1. Great fluctuations of permeability (quantities of filtrate per day) could be observed. In sandy soils the permeability may fall, in the conditions of the experiment, to 0.1 ccm. per day from 2 litres, in loam and gley soils it fluctuates from 0-200 ccm. per day. *The mechanical composition of the soil* offers only a small clue to its permeability

2. The fluctuations of permeability are greater in the loam soils the more these contain finest particles of such a size of grain as are not deposited in 3 weeks after raising the degree of dispersiveness. The fluctuations of permeability of those soils, which contain few grains of this arrangement of size, as for example level A of the Podsol soils, are relatively small, but the permeability is also small even under the action of electrolytes.

3. The permeability is in time considerably reduced by distilled water, in acid soils filtration ceases completely after a few months, as also in the neutral humus level ; in marl loam, however, it is only reduced, and still goes on after 1 to 1 ½ years from the beginning of the experiment. The explanation is to be sought in the combinations which are released from the soil by water : in acid soils the Na'' ion has the first place, but in the marl loam the $Ca^{\cdot\cdot}$ ion. If before the experiment the acid soil is neutralized, and $Ca(OH)_2$ filtered through it, then the filtration of the distilled water proceeds much better, and does not cease even after a few months.

4. The filtration of water containing greater quantities of CO_2 proceeds much better than that of distilled water. With that the permeability of marl loam with high $CaCO_3$ contents is particularly increased ; in acid soils the difference is smaller, but is very noticeable if the CO_2 content reaches 0.5 g. to the litre.

5. The permeability for 0.02 n $Ca(HCO_3)_2$ solution is very different, and is very greatly influenced by the absorbed $Na^{\cdot}$ ion content of the soil. The permeability of the marl loam is very good for this solution, if there is still no podsol soil developed on it, or if it is taken from deeper levels. The permeability for this solution is

also good in level B of the podsol soil, whilst the permeability of the upper level of the acid soil is pretty small, which may well be explained by the strong absorption of the $Ca^{\bullet\bullet}$ ions. Very great differences of permeability for this solution are also observed in the gley loams. The permeability of the gley loam from Kasdanga, which contains considerably more absorbed $Na^{\bullet}$ ion, is very small, even smaller than for distilled water. If before the experiment the lime-marl is removed and at the same time the absorbed $Na^{\bullet}$ ion partially removed, then the permeability is distinctly greater.

It must also be noted that the $Ca(HCO_3)_2$ solution also contained free CO_2, with which the content of CO_2 showed great fluctuations, which might also influence the permeability.

6. The permeability for gypsum was fairly similar to that for $Ca(HCO_3)_2$, except for the marl loam on which podsol soil had developed, and the gley loam from Kasdanga; these are soils which contain great quantities of absorbed $Na^{\bullet}$ ion. The permeability was also good for gypsum in these soils, because in the exchange reaction not much $NaHCO_3$ could arise.

7. Especially great influence on the raising of the permeability in very acid gley loam (from Kasdanga) was exerted by such solution as contained $CaSO_4$ and $Ca(HCO_3)_2$ together, and therefore considerably more gypsum than hydro-carbonate of calcium. *The permeability of the very bad gley loam was in this case very greatly increased.*

8. The permeability of the neutral soils is very greatly raised by $Ca(OH)_2$ and remains very great for some months. The permeability of the very acid soils, on the contrary, is quickly reduced, and relatively quickly the filtration ceases completely. Where the permeability of the soil in the foregoing experiments has been found very low, it is not always possible to raise it to an appreciable extent by the application of $Ca(OH)_2$ solutions.

9. The permeability is considerably reduced by $NaHCO_3$ solution of even very weak concentration. If the soils contain no $CaCO_3$, then the finest constituent parts are much washed out; in such cases the permeability is sometimes even increased, but after a few days is again reduced and filtration ceases completely. Level A of the podsol soil, which contains very small quantities of the finest constituent parts, is not very sensitive to $NaHCO_3$. The negative nfluence of $NaHCO_3$ is greatest in gley soils with which the structure suffers most, if the gley soil contained any before the experiment.

An injurious influence is exerted even by concentrations of 0.00003 n $NaHCO_3$, i. e., less than 0.003 g. to the litre.

It is to be expected that even very diluted solutions of ammonia may have a retarding action on the permeability, especially those of the marl loams and clay soils. The degree of dispersiveness of the marl loams is already notably increased by very diluted ammonia solutions such as 0.0003 n, and the decomposition of the carbonate of calcium is even reduced by 0.0001 n ammonia solution.

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A CONTRIBUTION TO THE KNOWLEDGE OF THE DETERMINATION OF SOIL FERTILITY.

The life of micro-organisms in the soil is the result of the phenomenon of assimilation in its entirety. The vital processes are characterized by the surrounding of the chemical molecules in the living being and by a constant exchange between latent and kinetic energy. The carbo-hydrates contained in the soil, as also the nitrogenous organic substances, are assimilated, and exchange takes place in the cells of the carbo-hydrate and albumen. A part of the carbon and nitrogen is used to build up new living molecules, but the greater part of the carbon, in the form of carbo-hydrates and albumen, gradually disappears in the process of oxidation.

The decomposition products, being poisonous, are rejected by the cells, or deposited in a harmless form. The quantity of carbon-dioxide exhaled by the soil when there is free admission of air, shows us the living energy of the bacteria, as does also the easy decomposition of the organic substances in the soil. The heterotrophes find in the organic substances not only a source of energy for their breathing process, but also carbon and nitrogen food sources for building up new living material.

In the bio-chemical analysis of the soil, the concentration of hydrogen ions in the soil must always be kept in view. The absorbent, unsaturated soils of humid districts, which are rich in humus and colloidal clay, usually show an acid character. The following data plainly prove how both the number of the vegetative spores, of the bacteria in the soil, and also the quantity of carbon-dioxide exhaled by the soil, are influenced by the active acidity of the soil. The experiments were carried out for 24 days in soil with 20 % water at 20° C.

From these data it can be seen how important it is to observe the concentration of the hydrogen ions of the soil when making the experiment. Soils, the acidity of which rises to pH = 4.7 - 4, are very rich in easily decomposed organic substances, but the acidity is so great that the bacteria cannot develop sufficiently.

TABLE I. — *Influence of the acidity of the soil on the number of bacteria and on the quantity of carbonic acid in the soil.*

pH	Carbon contents of the soil in dry substance	Average quantity of carbon-dioxide exaled by 1 kg. of soil in 24 hours	Number of vegetative spores of the bacteria in 1 g. of soil
	%	mg.	Millions
7.2	2.58	85	78
6.9	2.17	90	76
6.6	1.93	66	52
5.8	2.64	48	20
5.3	1.87	22	16
4.7	2.88	9	8
4.0	3.16	5	6

With a concentration of hydrogen ions pH = 4, the number of bacterial vegetative spores varies, between 4 - 6 millions per 1 g. soil.

By the addition of calcium carbonate, namely, from 25-50 g. per 1 kg. soil, the acidity is paralysed, and the bacteria then find in the organic substances a good source of energy. The organic acids then no longer hinder bacterial assimilation. I append an example of this :

The peat soil of Sadskâ, which is not rich in ferro- and ferri-sulphates, has an acidity of pH = 4.2. This soil, with 20 % water, exhaled 8 mg. carbon-dioxide per 1 kg. in 24 hours at 20° C. Following the addition of calcium carbonate, namely, 50 g. per 1 kg. of soil, the quantity of carbon-dioxide exhaled under the above conditions rose after 30 days to 21.4 - 27 mg.

All organisms in the soil, require, for the construction of new living substances all the other biogenous elements in addition to carbon, which is always contained in the organisms up to 42-48 %. The form in which the biogenous elements, particularly nitrogen, are offered to the soil is not unimportant. In arable, meadow, wood and garden soils, types of bacteria predominate which either assimilate nitrogen from easily soluble substances containing nitrogen, or such as give the preference to ammonia salts, or bacteria which prefer nitrates. The rise in the intensity of breathing of the bacteria in various kinds of soil following the addition of organic or inorganic combinations containing nitrogen, depends on the character of the bacteria which predominate in the soil concerned. We have undertaken experiments in our experimental fields, also in the various arable and wood soils of Czecho-Slovakia,

on the effect of mineral, nitrogenous manures on the breathing intensity of the soils. I give here only a few examples, in order to show the different effects produced by manuring with sulphate of ammonia and Chili saltpetre on loamy, sandy soils, loamy lime soils, clay soils and humus soils.

The fact certainly remains that the application of mineral, nitrogenous manures increases the breathing intensity of the microorganisms of the soil, particularly in such soils as contain easily decomposed organic substances in sufficient quantity.

TABLE II. — *The quantity of carbon-dioxide produced in 24 hours from 1 kg. soil with 20 % water, at 20° C., and with 20 l. of air being passed through. In mg.*

Kind of soil	Unmanured soil	Soil manured with 80 kg. nitrogen per hectare in the form of *sulphate of ammonia*	Soil manured with 80 kg. nitrogen per hectare in the form of Chili saltpetre
	mg.	mg.	mg.
Loamy sandy soil	15.5	30.0	35.9
Loamy lime soil	38.3	49.0	58.3
Clay soil	27.5	32.4	35.8
Humus soil	32.0	36.6	44.2

From these data it can be plainly recognized what a great increase of breathing capacity the soil, especially the loamy lime soil, has acquired from the addition of sulphate of ammonia and sulphate of sodium. The breathing intensity was also raised with loamy sand soil and clay soil. The least effect was shown in humus soil.

The contents of carbon in the dry substance amounted to:

in loamy sandy soil	1.04 %
» loamy lime soil	1.16 %
» clay soil	1.53 %
» humus soil	3.28 %

By the constant use of mineral, nitrogenous manure, the humus substance in the soil is broken up to carbon-dioxide, and so the soil always suffers a shortage of carbon. The same appearance was shown on the application of superphosphates. The experiments were carried out in the same manner, and with the same

soils as in the experiments with nitrogen, except that 60 kg. of phosphoric acid in the form of superphosphate were used per hectare. In the following table the breathing intensity of the manured and unmanured plots of the various soils is quoted:

TABLE III. — *The quantity of carbon-dioxide, in mg., produced on an average in 24 hours from 1 kg. soil with 20 % water, at 20° C., and with 20 l. of air being passed through.*

Kind of soil	Unmanured soil	Soil manured with 60 kg. phosphoric acid in the form of superphosphate
Loamy sandy soil	15.8	19.4
Loamy lime soil	30.6	43.7
Clay soil	27.5	30.8
Humus soil	32.6	45.6

These data show that even with the addition of phosphoric acid soluble in water, an increase in the breathing capacity of the soil is effected, and this increase is greatest in the humus soils. Then follow loamy lime soil and sandy soil.

We have found in our laboratory experiments, and those on the experimental fields, that the increase in the production of carbon-dioxide with the use of stable manure is effected on one side by the native active bacteria of the stable dung, and on the other by the supply of its organic easily decomposed substances. This raising of the breathing intensity depends not only on the number of bacteria, but also on the degree of capacity for decomposition of the organic substances contained in the stable dung. In order to produce an increase of activity in the bacterial world in the soil the food molecules must split up into easily oxidizable decomposition products.

The stable manure must be so treated that it brings about a certain fermentation in the sense of oxide reduction. The decomposing processes of the organic substances are occasioned by the intermolecular respiration. *The action of the stable manure depends not only on the quantity used, but on the quality of the decomposable organic substances and on the activity of the bacteria.*

Even small quantities of stable manure can effect a notable increase of the respiration processes of the microorganisms. On

our experimental fields we have carried out experiments regarding the increase of carbon-dioxide production of the soil by stable manure. The soil of the experimental fields was a good loamy soil, which, calculated on the dry weight, showed a carbon content of 1.8 % and a calcium carbonate content of 0.3, and in 1 g. contained 46 million bacterial vegetative spores. The unmanured soil exhaled on an average 4.02 g. of carbon-dioxide per square metre in 24 hours. On the application of 200 quintals to the hectare of well treated stable manure containing 40 kg. nitrogen, an average of 5.03 g. carbon-dioxide per square metre in 24 hours was exhaled from the soil by diffusion. The experiment lasted 15 days. Air was conducted through the bell 6-8 hours daily.

On the application of 400 q. stable manure per hectare containing 80 kg. of nitrogen, 6.59 g. carbon-dioxide per square metre were exhaled in 24 hours by the same methods of experiment.

In order to prove that stable manure, in its action of increasing the production of carbon-dioxide, cannot be replaced by nitrogenous fertilizers, we have at the same time carried out manuring experiments with Chili saltpetre. We again used, as in the experiments with stable manure, 80 kg. nitrogen per hectare. After 15 days observation 5.58 g. carbon-dioxide per square metre was produced in 24 hours.

With the control plots, where no stable manure and no nitrogenous fertilizer was used, the production of carbon-dioxide amounted to 4.02 - 4.01 g. per square metre in 24 hours.

The experiments were proceeded with steadily for 30 days after the manuring with stable manure, urea or Chili saltpetre commenced, and were carried out in the month of September.

By the experiments made, our opinion which we had already expressed in the year 1906 was confirmed, namely, that stable manure is to be regarded as the best producer of carbonic acid. It was certainly of great interest to learn how green manuring affects the carbon-dioxide production of the soil. In these experiments we again used the same soil as in the experiments with stable manure, and made use of so much organic substance of *Lupinus luteus*, that there was again added the soil 80 kg. nitrogen per 1 ha. in the form of green plant manure. The green plant substance of *Lupinus luteus* was superficially ploughed into the loamy soil. and after 30 days the carbon-dioxide production of the soil was ascertained. By a 10 days' analysis it was determined that *on*

an average 5.03 *g. carbon-dioxide per square metre of soil was produced in 24 hours.*

In the experiments with stable manure we ascertained that, after the addition of 80 kg. nitrogen per hectare, in the form of stable manure, there was, after 15 days' observation, an average production of carbon-dioxide by the soil of 6.59 g. per square metre in 24 hours. By manuring with stable manure, therefore, the respiration intensity obtained is much greater than by green manuring, namely, by 1.56 g.

According to our investigations, every cultural plant possesses its own specific characteristics in the processes of photosynthesis and assimilation. This is to be traced to the dissimilar working efficiency of the cells containing chlorophyll and the cells without chlorophyll of the various plant organisms. Only now can we form a conception of the enormous quantities of carbon-dioxide assimilated out of the air under the influence of sun by means of carbon-dioxide reception. If during the development of the cultural plants the climatic vegetation factors are at a minimum, then of course the photo-synthesis sinks, and nitrogen, phosphorus, chlorine, sulphur, potassium, magnesia, aluminium, iron, etc. cannot be used so largely for the synthesis of cell building as they can when the vegetation factors are at their highest. On the climatic vegetation factors, therefore, depends the whole assimilation of the carbon-dioxide from the air, as also the resorption of the mineral foodstuffs out of the soil, and therefore the total working efficiency of the plant. In our case 96.8 q. carbon, 1.68 q. nitrogen, 2.20 q. oxide of potassium and 0.6 q. phosphoric anhydride were resorbed and used for the synthesis of cell building. For every 100 kg. of the assimilated carbon there escaped barely 1.74 kg. nitrogen, 2.27 kg. oxide of potassium and 0.62 kg. phosphoric anhydride. If the assimilation of carbon falls, then naturally the nitrogen, phosphorus, potassium etc. will not be sufficiently utilized, and will remain for the greater part in the soil for future vegetation. The resorption of the mineral food material from the soil is connected therefore in a certain way with the building and reconstruction of the cell contents.

It is a fundamental fact that under the natural conditions of growth, with the present state of the cultivation of the soil and the culture of plants, the carbo-hydrate factor is generally at a minimum. It has already been plainly prove by the investigations

of Fodor, Wolliny, Stoklasa, Bornemann, Fischer, Reinau and Lundegardh that by the respiration of the soil an enrichment of carbonic acid is effected in the ground layer of the atmosphere. The carbon-dioxide, which escapes from the soil by diffusion, owes its origin to the respiration of the *Auto-* and *Heterotrophes* in the soil. The results of our experiments, obtained 30 years ago, plainly show that a great deal depends, on whether the soil is well cultivated mechanically, manured and tilled, or not. Further, it is not a matter of indifference with what genus of cultivated plants the soil is planted. We were able to observe greater respiration energy of the micro-organisms in soil plated with beetroot and potatoes, than with soils set with cereals. The ascertained degree of air capacity, with all the soils investigated by us, stands intimately related to the quantity of carbon-dioxide exhaled. The greater the air capacity of the soil, the greater the respiration intensity of the micro-organisms in the soil. The determination made by us 30 years ago of the life activity of the *Auto-* and *Heterotrophes* in the soil, by measuring the quantity of carbon-dioxide exhaled, is a reliable method for ascertaining the intensity of the process of exchange of matter of the *Auto-* and *Heterotrophes* in a given quantity of soil. The quantity of carbon-dioxide produced in a given time, at a given degree of humidity, and at a fixed temperature, gives us an exact picture of the size and the mechanics of the physiological combustion. The respiration intensity shows that there is present in the soil not only a considerable quantity of active bacteria, but also decomposable organic substances. By taking into consideration all the factors just mentioned, the quantity of carbon-dioxide produced on an average in 24 hours from the micro-organisms of various kinds of soil gives us a means of comparison for the output of the micro-organisms in the soil. We find that the respiration intensity of the various micro-organisms varies extraordinarily, and is dependent on different vegetation factors. The quantity of exhaled carbon-dioxide is an indicator of the fertility of the soil. On the basis of our observations, we can maintain that with soils of a different degree of fertility, the quantity of carbon-dioxide exhaled per 1 kg. soil in 24 hours, with 20 % water contents, and at 20° C., varies tremendously. The results obtained from observations and analyses, extending over many years, on arable soils of Bohemia and Moravia, are put together in the following table :

TABLE IV. — *Quantity of carbon-dioxide exhaled from the soil, as a measure of fruitfulness.*

Nature of soil	Quantity of carbon-dioxide per 1 kg. soil in 24 hours	Quantity of carbon-dioxide per hectare in 200 days from a layer 30 cm. deep	Carbonic acid, reckoned on the lower limit of CO_2 production at the time
	mg	q.	q.
Fruitful soils which bear, per hectare 25-30 q. corn, 350-400 q. beet	60 – 120	480	131.08
Less fruitful soils	30 – 60	240	65.54
Unfruitful soils	15 – 20	120	32.77

The carbon-dioxide is in part exhaled from the ground by diffusion, partly absorbed by the water and the carbon is redeposited in the soil in the form of bicarbonates.

In any case the quantities of carbon-dioxide produced from various kinds of soil, which escape from the soil by diffusion, are of interest. According to our investigations, when the temperature of the soil planted with various cultures is 13 - 17° C., this amounts to:

TABLE V. — *Carbon-dioxide production of various kinds of soil.*

Kind of soil	Carbon-dioxide per 100 kg. in 24 hours	Carbon-dioxide per ha. in 200 days	Carbonic acid production in
	g.	q.	q.
Fruitful soils	6 – 8	120 – 160	32.73 – 43.63
Not very fruitful soils	4 – 5	80 – 100	21.82 – 27.27
Unfruitful soils	2 – 3	40 – 60	10.91 – 16.36

We see what extraordinary quantities of carbon-dioxide are produced from the soil in 200 days, and what fundamental importance the respiration of the soil must have for the nourishment of the cultural plants. The plants are not exclusively dependent on the carbon-dioxide contents of the free atmosphere, but the leaves also assimilate the carbon-dioxide escaping from the soil, and so a great addition of carbon is made possible for the plant organisms.

Of course, an increased respiration of the soil means also an increased demand for a store of humus in the soil, for which the organic residue of the individual kinds of our cultural plants does

not suffice. The total quantity of stubble and root remains which are left in the fields after the harvest, although considerable, are not sufficient.

TABLE VI. — *Stubble and root residue left per hectare.*

Kind of plant	Dry weight of the plant substance	Carbon content	Carbon
	kg.	%	kg.
Rye	4328	44.8	1938.94
Wheat	4316	49.7	2145.05
Oats	4285	49.1	2103.93
Barley	4894	50.6	2449.93
Red Clover	9163	46.9	4297.44
Lucerne.	11432	45.2	5167.26

These figures show plainly the quantities of carbon which remain in the stubble and root residues of the individual cultivated plants, and how important it is to put clover and lucerne in the crop rotation. In all countries in which clover and lucerne are little cultivated, as for example in some districts of Czechoslovakia, Poland, Jugoslavia, etc., the carbon content sinks, and even manuring with phosphoric acid and potash cannot be utilized with full effect. By the influence of the organisms in the soil the withered root system is gradually decomposed, the celluloses, pentosanes, etc. hydrolysed and further decomposed (1).

It must in any case be taken into consideration that by the bio-dynamic processes of the micro-organisms in the soil, a certain quantity of carbon is collected in the vital layer of the soil, though here it is only a question of a few hundredweights per year. It has so far been impossible to determine the exact quantities satisfactorily.

The deeper we penetrate into the knowledge of the processes taking part in the bio-dynamics of the micro-organisms of the soil, the more we get the impression that the micro-organisms in the soil in a certain sense co-operate. This applies particularly to the autochthonal flora according to WINOGRADSKI, and the microbes occurring in the soil in the form of spores, and which only have the opportunity of vegetative growth by alterations in the soil, or under the influence of added inorganic manure, such as nitrate of ammonia, nitrate of potassium, nitrate of soda, calcium-nitrate, sulphate of ammonia, and of organic substances such as

urea, organic plant material and stable manure, also phosphates, as we have already mentioned. The activity of the bacteria, fungi, actinomycetes and protozoa depends mainly on the decomposition of cellulose which is easily decomposed and of lignin which is very resistant to decomposition, because the cellulose represents a very important carbonaceous material for the provision of energy and the exchange of matter of the micro-organisms of the soil. If besides cellulose there are merely small quantities of nitrogenous organic substances in the soil, then the process of decomposition is quite different to that shewn in the presence of large quantities of nitrogenous organic and inorganic substances and easily soluble phosphoric acid. In this case the cellulose is much more energetically decomposed, and the intermediary products formed by the decomposition of th cellulose and the nitrogenous organic substances will serve as valuable material for building up new living molecules of the micro-organisms. SELMAN A. WAKSMAN (2), in his classic work "The soil population", has described these living processes of the bacteria in an excellent manner. When all vegetation factors are present, the vitality of the bacteria rises energetically, and the organic substances are quickly decomposed.

Assuming that the soil contains even 2 % *carbon, then* 1 *ha. of soil, to a layer of* 30 *cm., contains* 80 000 *kg. carbon. If the fertile soil exhales* 40 *q. of carbon in* 200 *days, then, if no replacement of the carbon takes place, the store of carbon in the soil would be exhausted in* 20 *years. The carbon content of the stubble and root residues of our cereals is not sufficient to cover the deficit. The farmer sees here how extraordinarily important it is to keep the carbon ratio constantly in view.*

We are compelled always to introduce organic substances along with mineral manures, because the organic substances in the soil are much more energetically decomposed in the presence of nitrogen, phosphorus, potassium, calcium and iron. By the conveyance of easily decomposable organic substances, and a great number of active, rhizo-spherical bacteria in the form of bacterial manures, the production of carbonic acid is uncommonly increased, the formation of bicarbonates in the soil proceeds very energetically, and the fertility of the soil is raised.

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NOTES AND LITERATURE.

(1) A striking difference is seen in the development of the garden flora on the coasts of Istria and Dalmatia as compared with the French and Italian Riviera. On the French and Italian Riviera a great quantity of stable manure, especially horse dung, is used; in Istria and Dalmatia, on the contrary, relatively very small quantities. On the French and Italian Riviera the soil contains 1.3-2.4 % of carbon and, calculated in dry weight, 40-110 million active bacteria per 1 g. The soil in Istria and Dalmatia contains 0.5-0.6 % carbon, and, calculated on the dry weight, 10-20 million bacteria per 1 g. of soil. The poor results in the cultivation of garden plants on the coasts of Istria and Dalmatia can be explained by the bad heating of the soil in the night. The samples of soil from the French and Italian Riviera, which were taken from a depth of 30 cm., exhaled on an average 70-120 mg. carbon-dioxide per 1 kg. in 24 hours, with 20 % water-content, at 20°C. The soil in Istria and Dalmatia, on the other hand, under the same conditions, exhaled on an average scarcely 30 mg. carbon-dioxide.

(2) SELMAN A. WAKSMAN: The soil population. *Proc. of the Nat. Acad. of Sciences* (U.S.A.), Vol. 11, No. 8, p. 47.

ON THE DEGREE OF HUMIFICATION OF THE DEAD COVERING OF FOREST SOILS.

The nutrition of trees in the forest depends, to a great extent, on the quantity and the composition of the nutritive matter contained in the superficial layers of the dead matter covering the ground and of forest humus. The organic matter which covers forest soils, contains an abundant reserve of nutritive elements; this absolute wealth, however, has only a very relative importance for them. To get a more precise idea of the quantity of organic matter which the trees can profit by, it would be necessary to determine the proportion of organic matter utilizable by plants. The appearance of the different forms of forest humus originating under different kinds of forest trees demonstrates to us considerable differences in the chemical composition of the organic matter and in its aptitude for being subjected more or less readily to the processes of natural decomposition. To make clear the different degrees of decomposition of the dead covering and humus which is formed under the different species of forest trees, I have tried, in the present paper, to apply a new laboratory method enabling the degree of humification of organic matter to be determined.

By causing a 6 per cent. solution of peroxide of hydrogen to act on forest humus and by boiling the liquid at a moderate temperature, it is possible to render the humified organic matter soluble in water, while fibrous organic substances, such as cellulose and lignin remain intact. According to ROBINSON (1) by the action of oxygenated water the humified matter undergoes oxidation and is brought to a condition of soluble compounds, while the attack on fibrous substances remains negligible.

In the following table the results of my experiments on the humification of the superficial layers of humus and vegetable mould rich in organic matter from the forests of spruce, Scots pine and pedunculate oak in the forest of Jirny near Prague, is summed up. These results are compared with the intensity of nitrification, ex-

(1) ROBINSON, G. W. and JONES, J. O. *Journ. of Agric. Science*, 15, p. 26, 1925.

pressed as difference between the initial content in nitric nitrogen and that after the sample examined had remained for 30 days in a conical phial under laboratory conditions.

TABLE I. — *Forests of spruce, Scots pine and pedunculate oak. Forest of Jirny.*

Species of forest	Percentage of organic matter in the dry substance	Percentage of humified matter in dry substance	Percentage of humified matter in organic matter	Active acidity pH	Nitrogen of nitrates mg. per 1 kg. of dry substance. Difference after nitrification
Spruce, 100 years, soil covered with moss.	54.16	12.83	23.69	3.8	— 10.25
Spruce, 90 years, soil covered with moss	51.20	30.09	59.94	4.8	— 4.37
Spruce, 100 years, open, soil covered with moss	31.21	20.02	66.07	5.0	— 0.80
Spruce, 70 years, close, soil without vegetation	30.64	21.16	69.04	5.6	+ 4.71
Scots pine, 60 years, veget. moss	22.59	4.16	20.00	3.2	— 0.00
Scots pine, 120 years, veget. moss, grass	18.39	0.42	34.90	4.2	− 0.50
Scots pine, 100 years, veget. moss, grass underwood of oak 10 years	48.37	30.02	62.06	5.4	+ 3.20
Scotspine, 30 years, veget. grass underwood of oak 20 years	21.01	12.72	60.57	6.2	+ 9.77
Ped. oak, 100 years, veget. moss, grass.	23.19	11.33	48.86	5.0	13.26
Ped. oak, 80 years, open, underwood oak 10 years, veget. grass	34.33	18.49	53.86	5.2	+ 1.96
Ped. oak, 80 years, open, veget. grass	52.56	33.00	62.78	5.7	+ 3.75

It is seen from the data in Table I that the proportion of humified matter contained in its entirety in organic matter increases in the cases examined of the humus of spruce, Scots pine and pedunculate oak, with the decreasing acidity of the vegetable mould.

The strongly acid layers of the dead covering under close growing conifers and pedunculate oak hardly produce any nitric nitrogen, with the exception of the more open forests with sweeter humus richer in humified matter, although the intensity of nitrification always remains very low.

Tables II and III include the results of experiments in the forest region of St. Margueritte near *Jindřichiw Hradec* and in the region of *Třemošnice* near Čáslav in Bohemia.

TABLE II. — *Forests of St. Margueritte near Jindřichiw Hradec, Bohemia.*

Species of forest	Percentage of organic matter in the dry substance	Percentage of humified matter		Active acidity pH	Nitrogen of nitrates mg. per 1 kg. of dry matter. Difference after nitrification
		in dry substance	in organic matter		
Ped. oak, 80 years with underwood of beech. Soil without vegetation . . .	38.78	32.04	82.62	5.9	43.85
Spruce, 80 years, close. Soil without vegetation	42.49	17.32	40.76	4.1	2.66
Oak, beech, silver fir, spruce. Hartig's felling area, 70 years. Soil without veget.	45.07	24.86	55.16	4.9	14.15
Scots pine, 70 years, without underwood .	81.34	31.39	38.59	4.2	14.03
Scots pine, 60 years, with underwood of beech, 20 years	64.00	35.37	55.27	5.4	21.72

TABLE III. — *Forests of Třemošnice near Časlav in Bohemia.*

Species of forest	Percentage of organic matter in the dry substance	Percentage of humified matter		Active acidity pH	Nitrogen of nitrates mg. per 1 kg. of dry matter. Difference after nitrification
		in dry substance	in organic matter		
Spruce, 90 years, soil without vegetation.	52.38	16.28	31.08	4.0	— 9.00
Spruce, 70 years, soil without vegetation.	69.29	29.39	33.88	4.8	12.63
Clearing of spruce forest 2 years after deforestation. Vegetation: — *Epilobium angustifolium, Rubus idaeus, Deschampsia flexuosa* etc.	34.21	28.13	82.23	5.4	108.03
Beech, 70 years, soil without vegetation .	43.47	22.14	50.93	5.2	0.17
Beech, spruce, Scots pine, 70 years soil without vegetation	36.85	18.34	49.77	5.1	33.40
Hornbeam, young coppice of 20 years.	25.25	17.52	69.27	5.6	99.06
Beech, hornbeam, maple, ash, young coppice of 20 years	18.17	13.25	79.92	6.0	49.87
Beech, maple, hornbeam, ash, high forest of 70 years. *Anemone nemorosa*. . .	28.72	21.94	76.39	6.5	193.98

It appears from the above mentioned experiments (Tables II and III), that the layers of humus in broad-leaved forests generally

show a very considerable degree of humification and at the same time a lively intensity of nitrification.

The acid humus of conifers, exposed to the action of sunlight is more easily rendered soluble than that found under the dense shade of the crowns of the standing trees.

In high forests of Scots pine, the favourable influence of the beech underwood is shown by the greater degree of humification of the superficial layer of humus. The same observation appears from the comparison of close grown forests of conifers with mixed stands composed of broad-leaved species and species with persistent leaves.

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Abstracts and Literature.

General.

A New Soil Core Sampler.

POWELL, E. B. (Missouri Agr. Exp. Sta.), *Soil Science*, Vol. XXI, pp. 53-57. Baltimore, Md., 1926.

The author describes a sampler that would take an undisturbed core of soil with the desired dimensions. The sampler consists essentially of two cylinders, one within the other, the outer one being furnished with cutting knives. A diagram of the sampler with a detailed description of its construction and two photographs are given in the article. Anyone especially interested can make arrangements with the Agricultural Experiment Station Columbia, Mo., U. S. A. to secure blue prints and specifications of this sampler. J. S. JOFFE.

Tschermak's Mineralogical and Petrographic Review.

New Series ; Vol. 38 ; 623 pages ; 93 illustrations ; 11 tables ; Published by Hölder-Pichler-Tempski A. G. Vienna 1925.

The 38th volume of this review appears as a special number in honour of the 70th birthday of FRIEDRICH BECK and as such is particularly well got up. Contributions have been sent by a large number of his former pupils, and of them this number contains thirty-five. Most of the contributions deal with mineralogical and petrographic problems, but to a soil-scientist the following will be of particular interest : (1) On the formation of the phosphates of lime in the gault of the Vorarlberg (p. 206-209) ; (2) On the weathering processes in the augite-porphyrites (melaphyres) of the Waldenburg highlands (p. 309-352) ; (3) Structure-statistics (p. 392-423) ; (4) On the numerical treatment of the structural properties of rocks

(p. 479-493) and (5) On the Cenomanian phosphate deposits in the Dnjester districts of Polish Podol (p. 599-609). In article (1) SCHADLER describes the diverse forms of occurrence of the phosphates of lime (phosphorites) in the glauconite sandstones and limestones. In article (5) TOKIERSKI deals also with the phosphates. He describes the geological and petrographic relationships of the Podolian phosphates, and deals also with their chemical composition and their economic importance for Poland. Article (2) of MILCH and ALASCHEWSKI forms a very valuable contribution to the knowledge of the relation between the habit, chemical processes and the changes in mineral composition of weathering rocks. Unfortunately lack of space prevents us from dealing with this most interesting paper in greater detail, but the reading of it can be recommended to every soil-scientist. The same applies to articles (3) and (4) on the structure of rocks which give very valuable suggestions when applied to soils. HELLMERS.

Soil Physics.

On the Mechanical Analysis of Soils containing Heavy Minerals.

MARCHAND B. de C., *South African Journal of Science*, Vol. XVIII, pp. 223-226. Johannesburg, 1922.

In the Transvaal many red loams are derived from basic igneous rocks like norite and diabase, which in some places contain bands of magnetite. Such soils consequently also contain a relatively high percentage of heavy minerals, principally magnetite. The author has examined the fine gravel and sand fractions — where a separation of heavy minerals by THOULET's solution is possible — and has found in the sand as much as 39 per cent. heavy minerals (30 per cent. magnetite).

It is clear that sedimentation and elutriation methods of mechanical analysis would not give a correct idea of the smaller sized fractions of such soils, such fractions no doubt containing also a high percentage of heavy minerals. The author sought after a method for reducing these soils to a common basis, but without success, it being impossible to separate the soil as a whole into heavy and normal particles. MALHERBE.

The Contribution to the Discolloidity of the Soil.

SMOLÍK L. Příspěvek k diskolloidním proměnám v půdách, *Věstník Ceskoslovenské Akademie Zemědělské*, p. 221. Prague, 1926.

The colloidal state of the soil is not constant. It depends on the action of temperature (freezing) on the different electrolytes (fertilisers) and on ploughing. These factors may modify the total surface and consequently the hygroscopicity which is proportional to it. The variability of the total surface of the soil has been studied in connection with the disthermical influences. The hygroscopicity has been determined as well as the absolute dessication of the soil after RODEWALD-MITSCHERLICH, and the activity of catalase with the apparatus of KOENIG. The author gives a few results:

1) The total surface of the soil particles is a function of the temper-

ature at which the soil was dried. The hygroscopicity of the soil decreases with increase of temperature. Air dried soils shrink about 11-15 % of their surface. This decrease of the active surface is, from a practical standpoint very important, for the production of nutritive substances in the soil after a hot summer. The total surface of soils dried at 50° and 100° is reduced only by about 0.7-5.6 %. With absolute dessication the surface is decreased by about one-fifth for mineral soils, and two-fifths for peat. It seems that the temperature has greater effect on the pectisation of humus than on that of other organic matter.

2) The activity of catalase of the dried soil decreases with hygroscopicity (except at a temperature of 50°).

3) Intermittent frost has little action on the shrinkage of the surface of air dried soils. On the other hand the surface of the moist soil is increased about 4 %. In the case of air dried soils the activity of catalase is decreased by about 3.5 cm^3 oxygen, in the case of moist soils by about 4 cm^3.

4) The leaching of electrolytes, if continued sufficiently (20-27 litres of water for about 150 gms. of soil) causes the peptisation of hydrogels, and the hygroscopicity increases about 10 %. The activity of catalase is also increased. When on the contrary the electrolyte content of the soil is increased, the total surface of the soil is decreased.

5) The variations in the colloidal state, which have begun under the influence of temperature, are only partly reversible, over a short period.

AUTHOR.

On the Chemical Changes in Granites under Moors.

BLANCK, E. and RIESER A. *Chemie der Erde*, Vol. II, part 1, pages 15-48. Jena 1925.

This piece of work is a contribution to the elucidation of the question of kaolin formation. Before dealing with their practical work, the authors review critically all the different views propounded on the formation of kaolin. As the object for their investigation the authors chose "brocken" granite, and their investigations and analyses were not concerned only with the granite, but also with the overlying peat and moor-waters. They investigated also atmospherically weathering granite particles. The results of these investigations are given in numerous analytical tables. The authors conclude that the weathering of the "brocken" granite does not tend in the direction of kaolin, and also that the bleaching of the rock is caused by the sulphuric acid formed.

HELLMERS.

Effect of Various Methods of Applying Fertilisers on Crops and on Certain Soil Conditions.

COE DANA G. (Iowa State College), *Soil Science*, Vol. XXI, pp. 7-21. Baltimore, Md., 1926,

Fertiliser applications in direct contact on the ridge or in direct contact in the drill-row with seed are likely to be injurious to the

best germination of the seed. Planters designed with fertiliser attachment for direct contact are not advised for use. In place of direct contact it is recommended to use the methods of " above the ridge or drill row " the " below the ridge or drill row " and the " sides of ridge or drill row " method. J. S. JOFFE.

The Effects of Various Methods of Applying Fertilisers on Crop Yields.

COE DANA G. (Iowa State College). *Soil Science*, Vol. XXI, pp. 127-141. Baltimore, Md., 1926.

This is the second part of a study (see above first part) on the effect of various fertilisers, applied in different ways, on some important farm crops. The results do not warrant definite conclusions, neither do they allow the recommendation of a satisfactory fertiliser practice. The experiments indicate, according to the author, some very sound suggestions. Moderate applications of non caustic fertilisers gave the best returns by the direct contact in the seed rows method. Drilling of fertilisers as a separate operation to the seeding was not equal to the direct contact method. A second set of delivery tubes distributing the fertiliser above the seed served to safeguard germination, but failed to give the benefits desired. When broadcasting discing is important. J. S. JOFFE.

The Solid Acidity of the Soil.

DE DOMINICIS, A. and DOJMI, S. (R. Istituto Superiore agrario di Portici). *Annali di Chimica applicata*, v. 15, No. 5, p. 183-206. Rome, 1925.

In the soil, bases may be found in a free or fixed state. The latter enter, in definite and constant proportions, into the composition of the molecule, forming part of the constitution of the crystalline and colloidal elements and cannot be separated without considerable chemical and structural alterations. The free bases, on the other hand, come at any rate for the most part, from the colloidal elements which cause them to he condensed by the action of a bond which differs from common chemical affinity ; from such compounds all characters of saline combinations are excluded.

Loss and impoverishment of bases in these compounds do not give them either the composition or function of acids or of acid salts. The peculiarity of abstracting the cation from electrolytes leaving the solution acid, is due in these conditions, to power of absorption. The energy of the absorbing power decreases in consequence of increase of the proportion of the fixed bases, which at a certain moment acquire the capacity of repassing into solution with very great ease. At this point, powers of absorption are still possible, inasmuch as the cations of the electrolytes go and take the place of the bases repassed into solution. The process, however, does not correspond to chemical reactions by double exchange.

Dissociation of the fixed bases cannot take place if the combinations from which they are derived, have not abandoned their coagulated condition. The increased degree of disjunction which results is the cause of

such an intensification of absorbing power on the part of the soil that the condition arises of the soluble nutritives elements remaining too actively abstracted from the action of the roots. In protecting the free bases from being washed away, carbonate of lime acts precisely through its nature of coagulant electrolyte. The conditions which calcium compounds are required to correct in soils already impoverished in free bases, are not therefore caused by the properties of non-existent or inactive compounds of acid function. In these cases, the calcium compounds do not act as neutralizers, but, on the contrary, by the known mechanism of coagulation of the electrolytes, that is by bringing back the colloidal elements from the dispensed condition to the condition of coagulated " absorbed elements " and fixing them in that condition. A. F.

Potassium Ferrocyanide and Ferric Ferrocyanide as Sources of Iron for Plants.

DEUBER C. G. (University of Missouri), *Soil Science*, Vol. XXI, pp. 23-26. Baltimore, Md., 1926.

The use of the compounds mentioned in the title as a source of Fe for *Sbirodela polyrhiza* and soybeans in solution cultures with buffer mixtures gave the following results : with 0.033 and 0.056 parts per million in the form of potassium ferrocyanide the soybeans and *Spirodela* made fair growth. Higher concentrations of iron in this salt produced a slight stoppage of growth. MERCK's ferric ferrocyanide was a satisfactory source of iron for soybeans plants when the solution had a reaction of pH 5.0 but at less acid reactions growth of the plants and chlorophyll development was restricted. J. S. JOFFE.

The Dynamics of Potash Assimilation by Potash containing Silicate minerals.

DOBRESCU-CLUY, J. M. *Chemie der Erde*. Vol. 2, Part 1. pages 83-102. Jena, 1925.

The absorption of food by a plant depends on the solubility of the given compounds in the available solvents. Purely chemical means cannot entirely solve the question of food absorption by plants, since in each case we are only able to determine the salts dissolved in a certain given solvent. The author investigated the question of food absorption using varying quantities of different potash minerals, and also different solvents. The results are summarised in tables and represented graphically. He points out that in the study of solubility the logarithmic function $\log (S - y) = K - C$ can be applied, which gives the velocity of monomolecular functions. For the determination of the velocity of solution the factor C serves, and not the factor S introduced by MITSCHERLICH. From the experiments of MITSCHERLICH it follows that the determination of P_2O_5 absorption is best carried out in water saturated with CO_2, whereas for the determination of potash assimilation hydrochloric acid is the best solvent. Mica supplies the soil with potash in a much more easily assimilable form than do potash-soda-felspars. HELLMERS.

On the Erratic Weathering Solvents in New Red Sandstone in their Dependence upon External Influences.

KLANDER, E. *Chemie der Erde*. Vol. 2, Part 1, pages 49-82. Jena, 1925.

The author has been investigating the new sed sandstone region of Reinhausen near Göttingen in which weathering causes the appearance of formations similar to those found in the new red sandstone of the Pfalz and in the freestone of the Saxon " Switzerland ". He has investigated very carefully the weathering solutions and has found in them mainly sulphate together with a small amount of chlorides. Usually the concentration of these solutions depended on the thickness of the percolated rock layer, their sulphuric acid percentage depending on the layers of humus overlying these rocks. This explanation is made the more probable by the presence of ammonium. HELLMERS.

Agricultural Chemical Exercises. Part I. Methods of Analysis.

MAIWALD, K. and UNGERER, E. Published by Theodor Steinkopff. Dresden and Leipzig.

As an introduction the scope of the book is clearly set out and defined and the most necessary apparatus and the rules to be observed in quantitative analyses are described. In the next part are described the fundamental methods of analysis and their application to fertiliser investigations (potash and phosphoric acid determination, methods of titration, determinations of nitrogen and lime). Two further chapters are devoted to the analysis of fodders. The last three chapters deal exhaustively with the different methods of soil analysis: physical methods, physico-chemical and chemical and biological methods. In the case of the more important methods e. g. waterholding capacity, ATTERBERG'S slime analysis, COMBER'S HASENBAEUMER'S and DAIKUHARA'S methods of acidity determination and foodstuff analysis the authors give a full description of the correct method of carrying out an experiment together with order of analysis; whereas other methods *e. g.* electrometric determination of the pH factor, determination of fertiliser requirements by the method of MITSCHERLICH, SCHONE and KOPECKY'S slime processes and the seedling methods of NEUBAUER and SCHNEIDER are just mentioned and the theory of them explained.

It is primarily intended to be a book of practical exercises for the use of students and college trained farmers. L. G.

Laboratory Book for Agricultural Chemists.

METGE, GUSTAV. Laboratory books for the chemical and related industries. Vol. 18; 232 pages. Published by Wilhelm Knapp. Halle, 1926.

The author divides his book into three main parts: natural soil elements, agricultural products, requirements of agricultural lands. In the first part he deals with the properties and with the methods of investigation of water and of soil. In the second he distinguishes between the methods of investigation of plant products and those of animal products, while the

last part deals with fertilisers and commercial foodstuffs both with regard to their investigation and the judging of them. Of particular interest from the standpoint of this journal is the second section of the first part : the soil. He deals with the physical, chemical and mechanical investigation of a soil, with the biological seedling experiments, with the investigation of moor-soils and also with the determination of substances detrimental to plant life. Even the most recent methods are described. The section closes with a chapter on the essential points to be observed in judging a soil.

The whole work reviews clearly with a guide to the literature on the subject the most important and most generally used methods of investigation and can be most strongly recommended as a concise handbook of research in scientific agricultural chemistry especially soil research.

L. G.

Soil Investigation by means of the Seedling Method.

NEUBAUER, H., *Illustrierte Landwirtschaftliche Zeitung*, Vol. 46, page 77, 1926.

The author, deals with and rejects various criticisms of the seedling method as worked out by him. He insists that his method should only be carried out by properly trained and scientifically educated workers. After pointing out the advantages of his method of determining plant-absorbable foods he remarks on the great sources of error inherent in pot and field experiments and claims that the lack of agreement of results between these and his seedling method does not in itself mean the rejection of the latter method. K. SCHARRER.

The Availability of Nitrogen in Garbage Tankage and in Urea in Comparison with Standard Materials.

PRINCE A. L. and WINDSOR H. W. (New Jersey Agr. Exp. Sta.), *Soil Science*, Vol. XXI, pp. 59-69. Baltimore, Md., 1926.

The object of the paper has been to study the relative availability of garbage tankage and urea in comparison with other organic and inorganic nitrogenous fertilisers and to study the rate of decomposition of urea under various conditions. Vegetation experiments were carried on in pots with sand cultures. Three crops were grown : barley, rape and sorghum It was found that the fertilising value of garbage tankage is very low. Most of the nitrogen which it contains is very slowly available and its total percentage of nitrogen is low in comparison with other forms of organic nitrogen. As a fertilising material its chief value will probably be in its use as a filler. Urea was found to be a very desirable source of nitrogen and was very nearly equal to $NaNO_3$ in availability. In some cases the crop was even better than with $NaNO_3$. In all cases it was better than $(NH_4)_2SO_4$. On the basis of 100 for $NaNO_3$, urea rates 98 % available ; $(NH_4)_2$ SO_4, 88.2 % ; standard tankage, 53.4 % ; fish 49.2 % and garbage tankage, 14.2 %. Chemical availability tests were made

by three methods: 1. neutral permanganate, 2. alkaline permanganate and 3. oxalic acid method of KELLOG (*J. Ind. Eng. Chem.* U. S. A., Vol. 16, pp. 371-372, 1924) and compared with the vegetation tests. Not much dependence can be placed on the present chemical tests for the determination of available organic nitrogen. The rate of decomposition of urea was studied in cultures of sand, of a mixture of half sand and half soil, and soil alone. The index for determining the decomposition was the amount of ammonia found over various time periods. After 5 days only 3 % urea was converted into ammonia in sand culture, 67 % in the half sand and 90 % in the soil alone. In the soil alone 50 % was converted in 3 days. On an acid soil the rate of decomposition was retarded: after 11 days only 50 % of urea was converted to ammonia.

J. S. JOFFE.

Numerous Reactions of Moravian Soils.

SMOLIK, J. Reakeni cisla moravskych pud. *Vestnik Ceskoslovenske Akademie Zemedelske*, p. 219, Prague. 1926.

The reaction of the soil depends on climate, on the parent rock, on the vegetation and on the way it is cultivated. The writer has analysed a great number of Moravian soils and he has published some results of the analyses in *Zorávy výzkumných ústavu zemedelskych c. s.* To make his results more general, he has continued this investigation on soils belonging to various types such as degraded tschernosioms, Central-European brown soils, grey forest soils, podsolized and podsol soils. He has also taken under consideration the endodynamorphian soils (in GLINKA's sense) such as redzinas, recent deposits, etc., and has examined the reaction of all characteristic strata in the soil sections.

To determine the actual reaction (in water and in the normal KCl solution) the process with the hydrogen electrode, an electrode of gold covered with palladium is used. The titrimetric acidity is expressed in milligrammes of H. ions per 100 grammes of dry soil.

It appears from his statement that:—

1) The pH concentration of Moravian soils varies from 4.90 to 8.57 pH. The arable soils always have a higher active pH concentration in water (6.40-8.57 pH), than forest and meadows soils (4.90-7.10) of the same climatic zone and derived from the same parent rock.

2) The exchanged reaction (in the KCl N solution) oscillates between the limits; 4.40-7.30 pH in arable soils; 3.70-6.30 pH in meadow and forest soils.

3) The titrimetric acidity in water reached 0.451, and in the KCl N solution 11.456 milligrammes H.

4) The highest active pH concentration was found in the redzina (8.57 pH) and then follow in order degraded tschernosioms, Central-European brown soils, grey forest soils and podsol soils. The illuvial strata of the last three types have a greater pH concentration than elluvial strata.

5) Neutral or alkaline Moravian soils — especially the redzinas — always show lower pH concentration determined by means of colorimetric

methods than by the electrometric method (with the hydrogen electrode).

6) The pH concentration determined colorimetrically in centrifugal apparatuses approximates to the pH concentration determined in suspension by the method with the hydrogen electrode.

7) The method with the quinhydrone electrode according to E. BILLMANN gives in Moravian soils (slightly) lower results than the method with the hydrogen electrode. Since that decrease is constant and operation is very simple to carry out, BILLMANN'S; method for the practice of pedology may be recommended.

THE WRITER.

Some Residual Effects of Neutral Salt Treatments on the Soil Reaction.

SPURWAY, C. H. and AUSTIN, R. H. (Michigan Agr. Exp. Sta.), *Soil Science*, Vol. XXI, pp. 71-74. Baltimore, Md., 1926.

This article deals with the effects, on the soil reaction of the various horizons of four soil types, profiles, of some different cations fixed by these soils from neutral salts (chlorides), after the soluble products of the soil neutral salt reaction have been practically completely washed from the soils. $CaCl_2$, $MgCl_2$, KCl and NaCl solutions were used in this investigation. The $CaCl_2$ caused only slight changes in the soil reaction whereas the $MgCl_2$, KCl and NaCl treatments increased the values of the soil. The effective order of the several cations is: Ca, Mg, K, Na. Increased solubility and hydrolysis of the soil material containing the fixed cations are believed to be the cause of the increased pH value where increases are noted.

J. S. JOFFE.

On the Influence of Soil Reaction in Practice.

TRÉNEL, M. Has the soil reaction in practical agriculture really the influence attributed to it as a result of scientific experiments? *Zeitschrift für Pflanzenernährung und Düngung*, Vol. 4, No. 8, 1925.

A contrast is made between the conditions of growth in practical agriculture, where optimum growth can be influenced by many different factors, and those obtaining in scientific investigations where all the disturbing factors are eliminated. It was shewn in previous experiments that throughout the year the reaction remains fairly constant particularly in the case of soils rich in colloids, but is less constant in the case of sandy soils poor in colloids. The influence of fertilisers and of soil cultivation was also investigated.

The answer to the question put by the author was based on the results of the numerous acidity determinations carried out by means of the "acidometer" on soil samples from 23 large estates. The results and computations were collected and tabulated very clearly.

These results agree to a certain extent with those gained from scientific experiments and it seems that we shall be justified in concluding that the yield can be be increased by adjusting the reaction of the soil to the kind of plant which it is intended to cultivate. Most of our cultivated plants seem to show an optimum growth at a slightly acid to neutral

TABLE I. — *Optimum soil reaction for the development of different cultivated plants.*

Cultivated plant	After O. ARRHENIUS	After TRÉNEL	
	Optimum at a pH of	Obsd. breadth of growth at pH of	probable optimum at pH of
Potatoes	5.2 – 6.3	4–8	5–6
Oats	5.6 – 8.9	4–8	5–6
Rye	4.5 – 7.8	4–7	—
Wheat	5 – 7	4–8	6–7
Barley	7.2 – 7.4	5–8	7–8
Sugar beet	7.5	6–8	6–7
Lupins	4 – 6	4–6	4–5
Peas	6.7 – 8.8	5–8	6–7
Red clover	6.0 – 8.4	5–8	6–7

reaction. As an alkali reaction is just as detrimental to the growth of cultivated plants as a strongly acid reaction, the problem of the dependence of plant cultivation upon soil reaction, seems to be not merely a question of "soil acidity" but a question of soil reaction in general.

G. L.

Dost known thy Soil, Farmer, its Ills and Maladies ?

TRÉNEL, M. *Illustrierte Landwirtschafts-Zeitung*, Vol. 45, page 623, 1925.

Dealing with the problem of soil acidity, the author points out with great emphasis that it is wrong to speak exclusively of "soil acidity diseases", since soil alkalinity is no less injurious to plant cultivation than a strongly acid soil.

K. SCHARRER.

The Utilization of Water by Plants Under Field and Greenhouse Conditions.

TULAIKOV, N. M. (Agr. Exp. Sta., Saratov, Russia), *Soil Science*, Vol. XXI pp. 71-91. Baltimore, Md., 1926.

The author studied the utilization of water by plants under field and greenhouse conditions. Under conditions of the investigation larger amounts of water are utilized during the first part of the vegetation period in the field than in the greenhouse. The loss of moisture must be ascribed to the indirect evaporation of water by the soil under the plants, something that does not take place in the greenhouse. For this reason the transpiration coefficients of all the plants in the field are higher than in the greenhouse during the first part of the vegetation period. For the majority of the early spring crops the utilization of water is not regular; there are specific periods when the plants require more moisture from the soil. With grain crops this period coincides with the period of heading out and

blooming. Plants with a long vegetation period — roots and tubers — are utilizing the soil moisture with great regularity during the whole period of their growth. Early maturing grain crops have to depend on the soil water resources, the late maturing plants may utilize the rainfall during the whole vegetation period and thus not be dependant so much on the soil moisture stored from the spring. In the field the following plants were used : winter rye and wheat, soft and hard spring wheat, oats and barley ; lentil peas and noot ; sorghum, Sudan grass and alfalfa ; buckwheat, corn, sunflower, potatoes, carrots, pumpkins and flax. In the greenhouse the following crops were used : soft and hard spring wheat, oats, buckwheat, peas, clover, flax and sunflower. J. S. JOFFE.

Proceedings of the 2nd Commission of the International Society of Soil Science .

Groningen, February 1926 ; Part A.

This is only intended as a short notice of the proceedings of the 2nd Commission which were made available to all the members of the International Society of Soil Science.

It contains 23 short papers by research workers of different countries dealing with the questions of chemical soil analysis, which were discussed at the Groningen session of the 2nd Commission on chemical soil investigation. The separate papers are reviewed in detail in the literature review of this journal. L. G.

S o i l B i o l o g y .

The Viability of the Nodule Bacteria of Legumes Outside of the Plant I. II.

ALICANTE MARCOS, M. (Univ. of Illinois), *Soil Science*, Vol. XXI, pp. 27-52. Baltimore, Md., 1926.

This paper covers a series of investigations on the problem of viability of nodule bacteria of legumes outside the plant. A series of experimental data is furnished on nodule production as influenced by time of storage, temperature during storage, kind of container, maintenance of organisms in pure and mixed culture in association with other nitrogen-fixing bacteria, with yeasts, moulds, and with non-nitrogen fixing bacteria on and in different media ; the effect of different treatments, such as the reinforcing of the inoculation with sugar, glue, and soil in various combinations and in different concentrations ; the effect of $CaCO_3$, $Ca_3(PO_4)_2$, sunlight, dessication and aeration was investigated. Extensive studies were conducted on the effect of time and dilution upon the number of the legume organisms surviving when grown in liquid media ; the effect of limited and ample quantities of oxygen upon the life of the organisms grown both in liquid and in solid media ; and the comparative effect of cane sugar and mannite upon the life of the legume organisms. The effect of soil acidity on the infective power of nodule bacteria was studied. It was found that when inoculated

seeds were variously treated with soil, glue and sugar, alone or in combination, some organisms remained viable and nodule production occurred after 60 days storage. In treatments with sugar, either alone or with glue or soil, the nodules developed were uniformly large and evenly distributed over the root system. Soil and glue showed no particular advantage over the untreated infusions. No significant difference in nodule production was noticed between sugar, $Ca_3(PO_4)_2$ and $CaCO_3$ in different amounts with infected soil when used for inoculation. Soils with 10 % sugar developed acidity unfavorable for *B. radicicola*. Cloth seed bags were superior for storage purposes to glass containers, *B. radicicola* and *Azot. chroococcum* showed no harmful effects upon the life and infecting power of the nodule bacteria. Soybean, sweet clover, cowpea, and garden pea bacteria, when grown together, showed no harmful effect upon each other. The activity of pea bacteria when grown on milk was not impaired by the presence of *B. prodigiosus*, *B. capsulatus*, *B. mesentericus*, pink yeast and moulds. J. S. JOFFE.

The Viability of the Nodule Bacteria of Legumes Outside of the Plant III, IV, V.

ALICANTE MARCOS, MONDEJAR (Univ. of Illinois), *Soil Science*, Vol. XXI, pp. 93-114. Baltimore, Md., 1926.

This paper is a continuation of I and II already reported and it deals with the effects of certain factors upon the life and growth of the nodule bacteria. The following factors were studied : dilution and storage, cane and mannite liquid media, oxygen supply in solid and liquid media for *B. radicicola*, shaking. The author also studied the thermal death point of nodule bacteria, *B. radicicola* and *Azotobacter chroococcum*, the effect of different kinds of soil, of $CaCO_3$ upon the thermal death point of legume organisms, the effect of soil acidity upon the infecting power of *B. radicicola* of garden pea ; studies were also made on the life cycle of various nodule bacteria as influenced by $CaCO_3$, $Ca_3(PO_4)_2$, acid phosphate, $AlCl_3$, HCl, CH_3 COOH, HNO_3 and H_2SO_4. It was found that the rate of multiplication was greater in high dilution. *B. radicicola* lived 142 days in solution. $CaCO_3$ stimulated the growth of *B. radicicola* better than $Ca_3(PO_4)_2$. The heat resistance of *B. radicicola* of garden pea and sweet clover and *B. radicicola* of cowpea and soybean was lower than the heat resistance of *B. radicicola* and *Azobacter chroococcum*. The legume organisms were killed at 50°C for 10 minutes exposure, whereas *B. radicicola* and *Az. chroococcum* were alive at 50°C for 10 minutes. Peat maintained the life of nodule bacteria at a much higher temperature than brown silt loam. Acid soils decreased the thermal death point of legume organisms. $CaCO_3$ increased the thermal death point and the keeping qualities of legume organisms. Absence of phosphate or carbonate in media resulted in the formation of bacteroids. Acetic, nitric and sulphuric acids changed the legume bacteria into bacteroids and each of these acids affected the form of the organisms specifically. J. S. JOFFE.

Some Protozoa found in Certain South African Soils.

I. FANTHAM H. B. and TAYLOR E. *South African Journal of Science*, Vol. XVIII, pp. 375-393. Johannesburg, 1921.

II. The same : *Ibidem*, Vol. XIX, pp. 340-371, 1922.

III. FANTHAM H. B. and PETERSON N. *Ibidem*, Vol. XX, pp. 438-49 1923.

IV. The same : *Ibidem*, Vol. XXI, pp. 445-479. 1924.

V. The same : *Ibidem*, Vol. XXII, pp. 355-399. 1925.

The above articles embody the first published data on the protozoan fauna of South African soils. Some hundreds of soil samples from the various regions in South Africa (humid, semi-arid, arid, temperate, sub-tropical) were investigated as to the number and species of protozoa occurring in them. Environmental factors, such as depth of soil sample, humidity, seasons of the year, soil reaction, frost, application of fertilisers, veldt burning, etc., were studied to some extent, but more from the zoological point of view. Practically nothing has been done to study the influence of protozoa on the fertility of the soil.

Over seventy different species of protozoa have thus far been recorded. In ordinary non waterlogged soils protozoa have normally not been met with in the trophic state. MALHERBE.

A Comparative Study of the Bacterial Flora of Windblown Soil : I. Arryo Bank Soil, Tucson, Arizona.

SNOW LAETITIA, M. (Wellesley College), *Soil Science*, Vol. XXI, pp. 143-165. Baltimore, Md., 1926.

Only those bacteria which grow aërobically were considered in this study. The soil under consideration was collected at depths of 6, 12 and 24 inches. The region may be called a " true arid " one. The number of bacteria per gram of fresh soil for the depths were as follows : 6 inches, 401 000 ; 12 inches 1 898 000 ; 24 inches, 916 000. Of the total number of colonies for all depths 52.4 % were actinomycetes, 0.77 % filamentous fungi, and 46.81 % yeasts and bacteria. The actinomycetes were actually and proportionally more numerous at 24 inches than at 6 or 12 inches. Pure cultures were isolated from the plates and studied morphologically and culturally. Morphologically, 24.1 % were cocci, 20.4 % were short non-spore bearings rods, 13.0 % were long non-spore bearing rods, 42.6 % were long spore-bearing rods and 64.8 % were Gram negative. Culturally 35.3 % fermented glucose ; 28.3 % fermented sucrose; and only one form fermented lactose ; 70.4 % digested gelatin and 56.5 % digested casein ; 32.6 % reduced nitrates to nitrites. J. S. JOFFE.

Soil and vegetation.

The Salt Requirement of *Lupinus albus*.

ARNDT, C. H. (Univ. of Pennsylvania), *Soil Science*, Vol. XXI, No. 1, pp. 1-6. Baltimore. Md., 1926.

This is a report of a study on the composition of a solution best adapted for the study of the physiology of *Lupinus albus*. Solution and sand

cultures were used and results are summed up as follows : a very favourable total salt concentration for the growth of *Lupinus albus* is 0.0084 N when calculated in respect of the cations. The salt ratio should be 5 : 3 :4 for K, Ca and Mg ; or 5 : 9 : 4 for the nitrate, phosphate and sulphate ions, respectively. A solution composed of 0.0035 N KNO_3, 0.0021 N $CaH_3(PO_4)_2$, and 0.0028 N $MgSO_4$ will produce a favourable growth when the H ion concentration is less than pH 3.6 High concentrations of phosphate tend to produce chlorosis. J. S. JOFFE.

The Lime question, Soil Reaction and Plant Growth.

ARRHENIUS, O. With 40 illustrations and 1 table, 158 pages. Published by Akademisches Verlagsanstalt m. b. H. Leipzig, 1926.

In this book, which the reviewer can heartily recommend, the author gives an exhaustive account of the views held as to soil reaction, its origin and its influence on plant growth and on the micro-flora of the soil, and also of the methods of its determination. In addition there is a chapter on the practical application of the experimental results. The very comprehensive collection of papers on the subject which is appended will be most welcome to all workers in this field.

It would require too much space to go in detail into the different views propounded, and the many suggestions thrown out, by the author. A study of the book itself is recommended and it should prove of the greatest interest to theorist and practical man alike.

R. H. GANSSEN.

Magnesia Impregnated Soils.

BLACKSHAW, G. N. *South African Journal of Science*, Vol. XVII, pp. 171-178. Johannesburg, 1921.

The so-called Great Dyke in Southern Rhodesia is about four miles wide and extends over a distance of approximately three hundred (English) miles. It is composed of basic igneous rocks, the principal varieties so far determined being serpentine, enstatite and norite. The soils derived from these rocks are red, chocolate-coloured, and black loams, the latter type occuring on the low lying ground, whereas the two former are found on the slopes. Without knowing their geological origin one would expect that they are fairly fertile, but the experience is that they are often most infertile and do not respond to fertilisers. Chemical examination revealed the fact that the infertile type contains a great excess of magnesia over lime when treated with hydrochloric acid as also with one per cent citric acid solution. With the fertile type the lime is in excess of magnesia in both solvents. The infertile type was no doubt formed from either serpentine or enstatite and the fertile one from norite. With the limited data at his disposal the author is of opinion that when the ratio of magnesia to lime, soluble in one per cent. citric acid, exceeds 3 : 1 (lime as 1) the tendency is to experience very poor yields of most of the common crops The Rhodesian experience is that Kaffir Corn (*Sorghum vulgare*), velve

beans (*Stizolobium* spp.), pearl millet (*Pennisetum spicatum*) and groundnuts (*Arachis hypogaea*) are fairly resistant to an excess of magnesia, whereas maize, wheat, lucerne, clover and mangolds do not tolerate an excess of magnesia. The native grasses (" sweet " grass) also thrive excellently on the magnesia impregnated soils. Liming these soils being locally impracticable, the most effective treatment thus far has been a liberal dressing of farm manure. MALHERBE.

Soil Reaction and the Growth of our most Important Cultivated Plants

TRÉNEL, M. *Illustrierte Landwirtschaftliche Zeitung*, Vol. 45, page 558, 1925.

The author describes the " acidometer " made by him and details the experiments he has made with it on the correlation of soil reaction and plant growth. K. SCHARRER.

Regional Soil Science.

The Distribution of the Main Agricultural Soil Types in Finland.

KRISCHE, P. *Die Ernährung der Pflanze*, 22nd Year, No. 5. Berlin.

In connection with the publication by the author in 1922 dealing with the main soil types in Czecho-Slovakia and in the same periodical review the author has brought out in collaboration with Prof. RINDELL of the university of Abo an exhaustive soil map showing the distribution of the main agricultural soil types in Finland. The map was based on the excellent map " Suomen Suot Finnlands Torfmaker " showing the distribution of moors in the middle and eastern parts of Finland, and published in 1909 by the Finnish Moor Union at Helsingfors, and also on the map sketches by BENJ. FROSTERUS " Finnlands Jordarter och Jordmaner *Geotekniska Meddelanden*, No. 34, Helsingfors, 1922. Supplements dealing with the heavy loamy and clay soils found in the southern parts of Finland were supplied by Prof. RINDELL. The map prepared from these sources shows that the Finnish soils consist mainly of moor soils with forest soils intervening, and that only the southern and western coastal regions contain some heavy soils while the districts round Jammerfors contain in addition some middle soils. Predominantly sandy soils are found in the districts north of Leningrad and south-east of Wiborg. In addition to the main map which proves the great importance of moor culture to Finnish agriculture, there is a map of the Finnish moors by Prof. RINDELL showing that the greatest part of the moor soils are in Central Finland. L. G.

The Origin of the Black Turf Soils of the Transvaal.

MARCHAND B. de C. *South African Journal of Science*, Vol. XXI, pp. 162-181. Johannesburg, 1924.

The black turf soils of the Transvaal and the adjoining provinces constitute a very interesting soil type about whose mode of formation much has been speculated in the past. The term " turf " is a specific South African

designation and does by no means mean a peaty soil. Farmers of the above provinces apply this term to heavy loams or clay soils and thus they also speak of *red* turf soils, meaning a heavy red loam or clay.

Some geologists were of opinion that the black turf soils contain a large percentage of humus and that they occur in low-lying or level localities with deficient drainage. Others however, observed that such soils may occur on hilly or sloping ground and that they are underlain by basic igneous rocks. From the study of South African soil literature and from observations made and from a few soil samples taken during a cursory visit through Africa by his colleague SCHANTZ, MARBUT (1) (America) expressed the definite opinion that the above black turf soils constitute a climatic soil type belonging to the tschernozem group and as such may be found on various rock formations. This stands in direct contradiction to the opinion of the Transvaal soil scientists who hold that the black turf soil is formed in situ from the weathering of certain basic igneous rocks only, under varying climatic and topographical conditions. In the above article the author defends this latter view and gives a very full description of the occurrence and characteristics of these black turfs.

Physically these soils are characterised by the very high amount of clay (particles below 0.002 mm.), the percentage ranging between 40 and 50. They are sticky and waxy when wet, and they crack and show a well marked crumbly structure when dry. Although black, the humus content of these soils is by no means high and the nitrogen is normally below 0.10 per cent. The loss on ignition varies from 5-10 per cent, but this includes some carbon dioxide and the water of hydration.

The soils are about 3-4 feet (90-120 cm.) deep, the black colour and the loss on ignition *remaining the same* throughout the whole soil profile. The black soil rests on yellow decomposing rock. Typical is the presence of (secondary) calcium carbonate. The first foot of soil usually contains a little and in the deeper soil it is visible as white concretions. At the transition level between the black soil and the decomposing rock there is present frequently, but not always, a real calcareous layer which in some cases, has been consolidated into hard massive limestone.

The black turf occurs in four big areas in Transvaal, of greatly divergent vertical distribution and with an annual precipitation ranging from about 20-30 inches (500-750 mm.). It is usually found on level or low-lying stretches of land but occasionally also on hilly situations. It always occurs as a sedentary soil on certain basic igneous rocks of similar chemical make-up in all the four regions. These rocks are norite, basalt and karroo dolerites. Plagioclase is the principal mineral and from this are formed by weathering kaolin, silicic acid and the carbonates of calcium and sodium. From the ferro-magnesium silicates, hydrated ferric oxide, silicic acid and magnesium carbonate result. All these weathered constituents are typical of the black soils, and from the above it is clear that the "clay" percentage would be high. This clay was analysed and it showed a very high silica-alumina ratio (about 60 % silica, 20 %

(1) SCHANTZ and MARBUT: *The Vegetation and Soils of Africa*. 263 pp., New York, 1923.

alumina and 15 % iron oxide). To this composition of the clay is ascribed the stickiness and impermeability of the wet soil, the result being that under the prevailing rainfall the carbonate of lime is not leached out. This explanation is the more probable, because *adjoining* the black turf soils there often occurs another very interesting soil type of the Transvaal, namely a chocolate-coloured or red heavy loam. This reddish loam is formed wherever the basic igneous rock is more ferruginous, such as the Pretoria diabase, the amygdaloidal basalt or other basic igneous rocks with bands of magnetite. The mechanical make-up of the black and the red types is practically identical, the red loams also containing from 40-50 per cent. " clay ". The chemical composition of this clay is, however, quite different to the first, the silica-alumina ratio being much smaller (about 42 % silica, 35 % alumina and 2 % iron oxide). The result is that the red loam is a well-flocculated soil and retains the crumbly structure also when wet. The soil thus remains porous and drains well, so that although it occurs under the same rainfall as the black turf and is also formed from minerals containing much " lime ", it seldom contains any calcium carbonate. This is the case throughout its whole profile which is some 15 feet (4 ½ meters) and more.

Why the colour of the relatively small amount of humus in the black turf soils should be so intensely dark, cannot yet be explained. Soil literature, however, mentions many cases where a black colour of the soil and a relatively high percentage of calcium carbonate go hand in hand.

All the above evidence goes to show that the black turf soils of the Transvaal are the normal decomposition product formed in situ from certain basic igneous rocks ; in other words, that the mother-rock and not so much the climate is responsible for this type of soil. MALHERBE.

Sol Formation and Classification.

MARCHAND, B. de C. *South African Journal of Science*, Vol. XXII, pp. 42-48. Johannesburg, 1925.

The author gives a brief general outline of soil formation and its characterisation according to the Russian school. He then discusses very briefly a few climatic soil types of the Transvaal and is of opinion that, owing to the comparatively low rainfall, the Transvaal soils are on the whole immature, *i. e.* consist only of the " C " horizon. There is, however, a strong tendency towards lateritisation especially in soils derived from basic igneous rocks. MALHERBE.

On the Formation of Soil from Diabase in Central Transvaal.

MERWE C. R. van der. *South African Journal of Science*, Vol. XXI, pp. 235 242. Johannesburg, 1924.

The soil resulting from the weathering of the (Pretoria) diabase in Central Transvaal is a deep reddish ferruginous soil. The author gives ultimate analyses of the fresh and the partly decomposed diabase rock as well as of the residual and subsoil formed from this rock. In addition the

results of three soil samples (done by the HCl extraction) from three different districts are given. The average annual rainfall (mostly during summer) of the above localities varies from 23 to 28 inches (584-711 mm.). The altitude varies from about 4,000 to 6,000 feet (1220-1830 metres) and the maximum temperatures also show great variation. The resulting soils from the diabase are, however, very similar in all respect. The author states that the " weathering is mainly due to chemical decomposition accompanied by solution and leaching of the more soluble ingredients ", such as carbonate of lime. MALHERBE.

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General Notices.

Report on the Meeting of the Second International Committee.

(Committee for Chemical Soil Analysis), Groningen, Holland. 2-6 1926.

The order of the day was as follows :—

Friday 2 April : The meeting was opened by the Chairman Prof. Dr. A. A. J. von 'Sigmond. Short explanations by the authors concerning the papers sent in. — Report of Messrs. Dr. H. R. Christensen and Dr. D. J. Hissink.

Discussion.

Saturday 3 April : Continuation of the Discussion.

Monday 5 April : Excursion under the direction of Egr. J. Heidema of Groningen. Study of the 1) high moor culture and 2) visit to the Polder and Kwelder regions.

Tuesday 6 April : Recapitulation of the conclusions and preparation for publication of the proposals for the I Congress of Soil Science (Washington, June 1927). — Official closing session in the University Building. — Visit to the University Building and reception by the Senate. — Dinner to the delegates.

All meetings, except the closing meeting, were held in the " Harmonie " building. The meeting was attended by 43 persons of 12 different nationalities. The following proposal was accepted :

DETERMINATION AND REVIEW OF SOIL ACIDITY.

I. *Preparation of the test.*

It is recommended that the soil should be examined in air dried state as soon as possible after taking the sample.

This point must be particularly observed when the buffer action is examined.

It is much to be desired that further examinations on the influence of drying and the fineness of the soil should be made.

II. *Methods of determination.*

A) *Determination of the state of reaction of mineral soils.* — In examining mineral soils it is proposed always as far as is possible to make the following determinations :

1) Determination of the pH index (firstly in water decantation and if possible also in KCl decantations) ;

2) Determination of the hydrolitic acidity ;

3) Determination of exchange acidity ;

4) Determination of buffer capacity ;

5) Determination of exchangeable lime (in soils with a higher humus content).

B) *Determination of the lime requirement of the soil.* — It is recommended while employing the Daikuhara process to take chiefly into consideration the

buffer effect of the soil towards bases and acids for the determination of the lime requirement.

III. *Practice of the methods of determination.*

a) In scientific investigations the execution of the electrometrical determination of the pH index (if possible by means of the Chinydron electrode) is always recommended. The determination must be done in a decantation (not in a filtrate) of the soil with H_2O or in a n-KCl solution.

Proportion of the soil to the liquid at the start 1 : 2.5.

The distilled H_2O used must have the carbonic acid tension of the outer air.

b) The hydrolitic and the exchange acidity must be made in the filtrate from the shaking of the soil with n-KCl or Na acetate and if possible, also with Ca acetate.

Indicator : Phenolphtalein.

Proportion of the soil to the liquid : 100 : 250.

Duration of shaking 1 hour. The number of c. cms. N/10 NaOH used in titrating 125 c.cms. of the filtrate must be indicated.

Note : Indication of the particular method of determination is recommended in all publications on soil acidity. If nothing else is said, the index pH stands for the water decantation.

IV. *Examination of the different methods for the determination of the state of soil saturation.*

For these determinations the following methods are recommended :—

A) For the determination of the exchangeable bases " S " :

1) The method of HISSINK.

2) The simplified methods of GEDROIZ, and more especially that with n NH_4Cl and that with 0.05 n HCl.

3) The method of KELLEY.

B) For the determination of the degree of saturation " V ":

1) The method of HISSINK ;

2) Direct conductometrical titration ;

3) The method of BOBKO-ASKENASY with $BaCl_2$;

4) The method of GEHRING-PEGGAU-WEHRMANN.

V. *Examination of the laboratory methods for the determination of the lime requirement of mineral soils in comparison with field experiments extending over several years.*

It is recommended that in the different countries as many field experiments as possible should be made according to the following plan :

a) without lime
b) quantity of lime 1/3
c) » » » 2/3
d) » » » 3/3
e) » » » 4/3

of the quantity of lime necessary for bringing the reaction index of the soil in question up to pH 7.0.

As a basis for the calculation of this quantity of lime by means of laboratory experiments the direct determination of the buffer capacity according ro the JENSEN-CHRISTENSEN method is to be employed. (Proc. Int. Soc. Soil Sci. XIV p. 112, 1924). It is desirable to use the other methods as well for the determination of the lime condition.

For the technical carrying out of the field experiments attention is called to the paper of CHRISTENSEN-JENSEN: "On the quantitative determination of the lime requirement of the Soil" (*Report on the Proceedings of the II Committee of the International Soil Science Association at Groningen*, pp. 113-114).

As ground-manure there ought to be employed:

N in the form of $(NH_4)_2SO_4$,

P_2O_5 in the form of superphosphate,

K_2O in the form of 40 % potassic salt in doses appropriate for the field but not too great.

It is intended to publish in a part *B* the proceedings of the meeting at Groningen with the resolutions and an exact description of the methods proposed.

Appointment on the Committee of the II Commission. — Following on the proceedings of the II Commission at Groningen Prof. Dr. O. LEMMERMANN was appointed Vice-President in accordance with par. 10 of the Statutes, thus completing the Committee.

Prof. Dr. A. A. J. v. 'SIGMOND.
President of the Committee.

Communications.

Prof. Dr. Lemmermann was elected President of the German Soil Science Society (A section of the International Society of Soil Science).

Director Dr. D. J. Hissink Groningen, formerly Departmental Director of the State Experiment Station has been appointed Director of an independent Soil Science Institute.

Supplement to the list of Members.

Germany.

139. Bibliothek der Landwirtschaftlichen Hochschule. Bonn-Poppelsdorf. Meckenheimer Allee 102, Bonn a. Rhein.
726. Forstliche Hochschule. Eberswalde.
715. Dr. Georg DEINES. Kirchweg, 15. Kassel.
735. M. DUTTENHOFER. Hindersinstrasse 8, Berlin, (NW. 40).
684. Prof. Dr. H. KAPPEN. Institut für Chemie der Landwirtschaftlichen Hochschule Bonn-Poppelsdorf. Meckenheimer Allee, 106. Bonn a/Rhein.
681. Dr. Paul KOETTGEN, Dozent für Bodenkunde am Forstinstitut der Universität. Phil. Gailstrasse, 8. Giessen.
737. Prof. Dr. F. LOEHNIS, Direktor des Instituts für Bodekunde der Universität. Johannisallee 21. Leipzig.

724. Prof. Dr. Emil WIMMER, Prof. der Forstwissenschaft. Sternwaldstrasse 31. Freiburg i. Bad.

Austria.

686. Landwirtschaftliche chemische Versuchs- und Untersuchungsstelle. Leiter : Ing. R. SCHRAFFL. Imst (Tirol).

United States.

685. Massachusetts Institute of Technology Library. Cambridge A., Mass.
687. The General Library. The University of Chicago. Chicago, Illinois.
442. Prof. Dr. Robert BALLENEGGER, State Agricultural College. Soils Department. East Lansing, Michigan.
717. J. F. BREAZEALE. University of Arizona. Tucson, Arizona.
721. John S. BURD. Division of Plant Nutrition. University of California. Berkeley, California.
719. STANLEY W. COSBY. University of California. 320 Hilgard Hall, Berkeley, California.
710. A. B. CUMMINS. The Celite Company. Lompoc, California.
710. P. L. GAINEY. Agricultural College. Manhattan, Kansas.
716. H. V. HALVERSEN. Department of Bacteriology, Oregon Agricultural College. Corvallis, Oregon.
711. ELMER H. JOHNSON. School of Agriculture. College Station. Texas.
718. Don W. PITTMAN. Agricultural College. Logan, Utah.
727. Prof. M. C. SEWELL. Kansas Agricultural College. Manhattan, Kansas.
722. Alfred SMITH. University Farm. Davis, California.
725. GORDON SURR. 321 Eight Street. San Bernardino, California.
729. M. D. THOMAS. Agricultural Experiment Station. Logan, Utah.

Finland.

680. Nordiska Jordbruksforskare föreningens subsektion för Kulturteknik (Prof. HALLAKORPI). Ahlqvistgatan, 5. Helsingfors.
678. Suomen Salaojitusyhdistys (Finlands Dräneringsförening). Hallituskatu 1. Helsinki.
679. Tekniska Högskolans lantmäteriavdeling. Boulevardsgatan, 27. Helsingfors.

France.

732. Prof. V. AGASONOFF. 4, rue due Chemin de fer. Bourg-la-Reine, Seine.
683. Georges TRUFFAUT. Etablissements et laboratoires. 90 bis, Avenue de Paris. Versailles.

England.

708. D. V. BAL. Rothamsted Experimental Station. Harpenden, Herts.
689. H. CLAYE. 9. Cavendish Avenue. Cambridge.

675. J. H. HUMPHREYS. Lecturer in Agricultural Science at the Llysfasi Farm Institute. Putkin (North Wales).
690. Dr. E. McKENZIE TAYLOR. 157. Hills Road. Cambridge.
704. Alex M. SMITH. 13, Viewforth Gardens. Edinburgh.

India.

405. Prof. N. GANGULEE, Khaira Professor of Agriculture. The University. Calcutta, Bengal.
392. Dr. A. N. PURI. Punjab Irrigation Resarch Laboratory. Lahore.

Canada.

674. Prof. D. G. LAIRD. University of British Columbia. Vancouver

South Africa.

755. Dr. M. J. VAN DER SPUY "Ons Rust". Mostert's Drift. Stellenbosch.

Hungary.

742. Zentralbibliothek der königl. ung. Hochschule für Berg- und Forstingenieure in Sopron.
682. Ing. Dr. ZOLTAN VON KUNREY. Gutsbesitzer. Ferenc József rakpart, 16, Budapest IV.

Italy.

359. Ing. Francesco BILBAO Y SEVILLA. Délégué de l'Espagne dans l'Institut Intern. d'Agriculture. Villa Umberto I. Roma (10).

Japan.

705. Prof. Dr. H. ASÓ. Agricultural Chemical Laboratory. Komaba, (Tokyo).
676. Yutaka KAMOSHITA. The Imperial Agricultural Experiment Station. Nishigahara (near Tokyo).
714. Prof. ICHIRO OHGA, Prof. of Ecology. Educational Institute. Dairen, Manchuria.
736. SHIGERU OSUGI, Prof. of Soil-Department of Agriculture. Kyoto Imperial University. Kyoto.
675. Gentaro YAMANAKA. The Imperial Agricultural Experiment Station. Nishingahara (near Tokyo).

Latvia.

740. Ing. Chem. Karl BAMBERG. Assistent an dem Laboratorium für Bodenkunde und Agrikulturchemie der landwirtschaftlichen Fakultät der lettländischen Universität. Kronvalda bulv., No. 1. Riga.
734. Direktor W. DUGMAN. Kulturtechnische Schule. Jacobsstrasse, 10-12. Riga.

739. Ing. Techn. Karl KRUMIN. Assistent an dem Laboratorium für Bodenkunde und Agrikulturchemie der landwirtschaftlichen Fakultät der lettländischen Universität Kronvalda bulv. n. 1 Riga.

738. Ing. Techn. Peter KULITAN. Dozent für Bodenkunde und Agrikulturchemie der landwirtschaftlichen Fakultat der lettländischen Universität Kronvalda bulv. n. 1. Riga.

Norway.

699. Byråsjef N. KROSBY. Oplysningskontoret. Landbruksdepartementet. Oslo.

700. Prof. J. LENDE. NJAA, Landbrukshøiskojen. Ås.

697. H. ROSENDAHL. Konservator. Universitetets mineralogisk-geologiske museum. Tøien. Oslo.

698. Prof. Dr. W. WERENSKIOLD. Universitetets geografiske institutt. Oslo.

Holland.

725. Laboratorium voor delfestofkunde der Technische Hoogeschool: Directeur: Prof. Ing. J. A. GRUTTERINK. Delft.

713. Prof. J. H. ABERSON. Wageningen.

712. Dr. C. W. G. HETTERSCHIJ. Scheikundige aan de tweede afdeeling van het Rijkslandbouwproefstation. Prof. H. C. van Hallstraat. Groningen.

Dutch Indies.

701. Dr. C. H. OOOSTINGH, Agrogeolog aan det Deli-Proefstation. Medan (Deli). S. O. K.

Roumania.

731. L'Académie d'Agriculture. Cluj.

730. Prof. Dr. M. CHIRITESCU-ARVA. Professeur d'Agrologie et Directeur de l'Académie d'Agriculture. Cluj.

Russia.

709. Forschungskathedre am Landwirtschaftlichen Institut, Vorstand: Prof. A. H. SOKOLOWSKY. Charkoff.

696. Prof. E. BOBKO. Landwirtschaftliches Institut. Omsk.

693. Prof. F. I. LEWTSCHENKO. Politechnisches Institut. Kieff.

695. Prof. G. MACHOW. Lermontowsky str. 26. Wg. 5. Charkoff.

692. M. G. PERESKOPOW. Akkawaksche Versuchstation. Postkiste, 101. Tashkent.

694. Prof. Dr. WILENSKY. Tschaikowskystrasse. 14. Wg. 8. Charkoff.

691. Prof. M. WOSKRESSENSKY. Polytechnisches Institut. Laboratorium für Bodenkunde. Nowotscherkask.

Sweden.

741. Prof. Dr. Daniel FEHÉR. Biologische Station. Hällands Väderö (via Land-Forekow).

Switzerland.

628. Hans BURGER, Assistent der forstlichen Versuchsanstalt. Zürich (Fluntern).
707. Dipl. Kultur-Ingenieur SCHILDKNECHT, Assistent der Eidgenössischen Technischen Hochschule. Turnerstrasse, 21. Zürich (6).
728. Dr. Paul TUORILA. Landwirtschaftliches Institut der Eidgenössischen Technischen Hochschule. Universitätsstrasse, 2. Zürich.

Czechoslovakia.

688. L' Académie Tschécoslovaque d' Agriculture. Jungmannova tr. 18. Praha II.
677. Stâtni vyzkumna stanice zemědělska (Staatliche Landw. Versuchsstation) Opavé.

Correction in list of Members.

Germany.

Bibliothek des Deutschen Kalisyndikates, G. m. b. H. Dessauerstrasse 28-29. Berlin S. W., *omit.*

Geologisch-paleontologisches Institut der Universität. Talstrasse 35 II. Leipzig.

Landwirtschaftliche Hochschule. Bonn-Poppelsdorf, *omit*, *see* Bibliothek

Stickstoffsyndikat G. m. b. H. Neustädtische Kirstrasse, 9. Berlin, M. W. 7.

Dr. KURT VON BUELOW. Invalidenstrasse 44, Berlin (N° 4).

Dr. G. GOERZ. Jagowstrasse 19, Berlin-Grünewald.

Prof. Dr. HARRASSOWITZ. Ludwigstrasse, 23. Giessen.

Prof. Dr. G. KRAUSS, Prof. für Bodenkunde und Standortslehre an der Forstlichen Hochschule und Versuchsanstalt. Tharandt (bei Dresden).

Prof. Dr. E. KRÜGER. Hannover, *dead.*

Prof. Dr. E. MITSCHERLICH. Tragheimer Kirchenstrasse, 74. Königsberg i. Pr.

Dr. R. NELKENBRECHER, Studienrat. Reimannstrasse 16 II. Salzwedel (Altmark).

Prof. Dr. E. RAMANN. München, *dead.*

Dr. VAGELER. Landwirtsch. Kammer. Beethovenstr. 24-26. Königsberg i. Pr.

Dr. Hans WIESMANN, Landwirtschaftliche Versuchstation. Rostck i. M.

Prof. Dr. Ing. F. ZUNKER, Direktor des Kulturtekhnischen Institutes, Hansastrasse 25, Breslau, 16.

Austria.

Prof. Dr. J. STINY, Technische Hochschule, Karlsplatz. Wien IV.

Cuba.

P. L. ANDERSON, Cuban Sugar Club, Apartado, 1973. Habana.
J. R. ZELL. Finca "El Conde", The Hershey Corporation. St. Antonio de Rio Blanco. Prov. Habana.

Denmark.

Afdelingen for Landbrugets Plantedyrkning. Den Kgl. Vet.-og Landbohjoskole. Director : Prof. K. A. BONDORFF og Prof. E. LINDHARD. Rolighedsven 23. København (V).
Den Kgl. Veterinaer-og Landbohjøskoles plantefysiologiske Laboratorium, Director Prof. Dr. Fr. WEIS. Rolighedsvej 23. København (V).
Statens Planteavls-Laboratorium. Director : Dr. H. R. CHRISTENSEN. Lyngby.
Statens Plantepatologiske Forsøg. Director : E. GRAM. Lyngby.
Prof. Dr. K. ROERDAM. Landbohøjskolen. Bulowsvej 13. København (V).

Egypt.

A. W. FAHMY, Chief of the Spraying Section, Entomological Section, Savoy House. Cairo.

Spain.

Ing. Fr. BILBAO y SEVILLA. Roma; *see Italy*.

United States.

Library of the Los Baños College. P. O., Los Baños. Philippines.
Soil Improvement Committee of the National Fertilizer Association. Washington, *omit.*
H. B. BAYLOR, Sales Manager. P. O. Box 1725. Atlanta, Georgia.
C. P. BLACKWELL. 804, Commercial Bank Building. Shreveport, Louisiana.
B. E. BROWN. Soil Fertility Investigations. Bureau of Plant Industry. United States Department of Agriculture. Washington D. C.
GUY W. CONREY. Department of Agronomy. Ohio Agricultural Experiment Station. Wooster, Ohio.
R. J. DE LOACH. Armour Fertilizer Works, 111, West Jackson Boulevard. Chicago, Illinois.
E. J. GRAUL. University of Wisconsin. Department of Soils. Madison, Wisconsin.
J. N. HARPER. 905 Hurt Building. Atlanta, Georgia.
F. A. HAYES. Conservation and Survey Division. University of Nebraska. Lincoln, Nebraska.
W. E. HEARN. Bureau of Soils. United States Department of Agriculture. Washington, D. C.
J. S. JONES. Oregon Experiment Station. Corvallis, Oregon.
P. D. KARUNAKAR, *omit.*

MACY H. LAPHAM, Associate soil technologist. P. O. Box 54. Berkeley, California.

LINWOOD L. LEE. Experiment Station. New Brunswick, New Jersey.

HENRY E. LEFEVRE. French Potash Society, 905 Hurt Building. Atlanta, Georgia.

C. H. MacDOWELL. Armour Fertilizer Works, III West Jackson Boulevard. Chicago, Illinois.

E. C. SHOREY. Bureau of Plant Industry. United States Department of Agriculture. Washington, D. C.

DOROTHY SILBERT Plainfield, *omit.*

A. M. SMITH. P. O. Box 1348. Atlanta, Georgia.

ROBERT MIFLIN SNYDER. College of Agriculture, Division of Veterinary Science. East Lansing, Michigan.

C. H. SPURWAY. College of Agriculture. East Lansing, Michigan.

S. A. WAKSMAN. Experiment Station. New Brunswick. New Jersey.

C. A. WHITTLE. 710 Wynne Claughton Building. Atlanta, Georgia.

France.

Ing. Charles GRANVIGNE, Ingénieur agronome, Directeur de la Station agronomique régionale de Dyon. 14, Avenue Victor Hugo. Dyon (Côte-d'Or).

England.

W. E. DE B. DIAMOND. School of Agriculture. Cambridge.

Prof. N. GANGULEE, residenza in Harpenden; *see India Br.*

Dr. A. N. PURI, residenza in Harpenden; *see India Br.*

Australia.

H. W. KERR. Bureau of Sugar Experiment Station, Agricultural Department Brisbane. Queensland.

Hungary.

Prof. Dr Robert BALLENEGGER; *see United States.*

Ing. Emil SCHERF, *omit, see Switzerland*

Anton VITAL, Budapest, *omit*

Italy.

Prof. Domenico PINOLINI, Direttore della Cattedra Ambulante di Agricoltura. Macerata.

Japan.

Dr. MASASHI ADACHI. College of Agriculture. Hokkaido Imperial University. Sapporo.

Siro HUDISE. The Kagoshima Imperial College of agriculture and Forestry. Kagoshima.

Dr. Agr. ADACHI MASASHI, *omit ;read* : Dr. MASASHI ADACHI.

Latvia.

Fräulein Dr. L. FREY. Ritterstrasse, 53. W. 6. Riga.

Lithuania.

Geologijos Kabinetas. Lietuvos Universitetas. Kaunas.

Norway.

Bibliothek der Landwirtschaftlichen Hochschule, sl. pr. Oslo Ås, *omit.*
Det Kongelige Fredriks Universitet Museum. Adresse : Universitetets Kasserei, Oslo, *omit.*
Dr. TORBJERN GAARDER. Laboratorium Vorsteher, Biokemisk Laboratorium. Bergens Museum. Bergen.
Prof. Dr. OLAF HOLTENDAHL. Universitetets geologiske-paleontologiske institut. Tøien. Oslo.
Docent A. E. TRAAEN. Det Mikrobiologiske Laboratorium, Norges Landbrukshøjskole. Ås.
Prof. Dr. J. H. L. VOGT. Norges tekniske højskoles geologiske institut. Trondjem.

Palestine.

Dr. F. MENTCHIKOVSKY. Agricultural Experiment Station. Tel Aviv.

Holland.

Directie van het Landbouwkundig bureau van het Kali-Syndikat. (den Herr H. LINDEMAN) Heerengracht, 342, Postbus 147. Amsterdam.

Dutch Indies.

Gouvernements Kinaproefstation, Tjinjiroean, Pengalengan bij Bandoeng, Java.
Proefstation Besoeki, Directeur : Mag. Sc. J. J. S. GANDRUP, Besoeki, Java.
Proefstation voor de Javasuikerindustrie. Pasoeroean, Java.
Redactie van de Indische Culturen. Soerabaja, Java.
Rubberproefstation West-Java. Directeur Dr. O. DE VRIES. Buitenzorg, Java.
Mevr. N. BEUMÉE. Nieuwland. Buitenzorg, Java.
P. W. HOUTMAN. Chef proeftuinen der Handelsvereeniging Amsterdam Paree (Karang Dinojo), Paree, Java.
Dr. M. G. J. M. KERBOSCH. Gouv. Kinaproefstation Tjinjiroean. Pengalengan bij Bandoeng, Java.
Dr. V. J. KONINGSBERGER. Cheribon, Java.

Poland.

Landwirtschaftliche Versuchsanstalt Post Lomza skr. 32. Kisielnica.
Dr. Benjamin CYBULSKI, Directeur du Foyer de la Culture Agricole et du Champ d'expériences. Kielce. Poste Skalbmierz. Sielec.

Dr. Slaw MIKLASZEWSKI. Rue Szopena 6. Varsovie.
Prof. Dr. Zygmunt STARZYNSKI. Kraków, *dead.*
Prof. Jean DE WLODEK, U. J. Aleja Mickiewicza 17. Kraków.
Prof. Dr. Jan ZOLZINSKI. Institut der Agrikulturchemie und Bodenkunde. Dublany bei Lwow.

Portugal

3ª Secção da Estação Agraria Nacional. Lisboa. Belem.

Roumania.

Institutul Geologic al României. Soseaua Kiseleff 2. Bucuresti.
Dr. P. ENCOULESCOU. Géologue chef à l'Institut Géologique de Roumanie. Soseaua Ardealului (Kiseleff) 2. Bucuresti.
Dr. Stefan KEREKES, Chemiker in der Zuckerfabrik, Romania Mare, Fabrica de Zahar, Marosvasarheli, 2. Targu-Mures.
Dr. Teodor SAIDEL. Chimiste-chef à l'Institut Géologique de Roumanie, Section Agrogéologique. Soseaua Ardealului (Kiseleff) 2. Bucuresti.

Serbia.

Prof. Dr. Ing. Adolf SEIWERTH. Vorstand des Bodekundlichen Institutes der Universität Mazuranic. Pl. 24, Zagreb.

Russia.

Institut Selskohosiajstwennych Melioratzyi, Selsko-Hosiajstwennaja Academia Direktor: Prof. KOSTIAKOW'Y. Petrowsko-Rasumowskoje. Moskau.
Prof. J. N. AFANASIEFF. Landwirtschaftliches Institut. Gorky, Weissrussland.
Prof. W. KASSATKIN. Iwanowo-Wosnessensk Polit. Institut. Minsk.
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W. W. NICKITIN. Ural landwirtschaftliche Versuchstation. Perm.
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M. N. SAYTZEFF. Universität, Institut der Landwirtschaft. Mochowaya 1. Moskau.
A. A. SKORZOW. Institut der Bodenkunde und Geobotanik. Obuchowsky 14. Tashkent.
Prof. A. N. SOKOLOWSKY. Vorstand des Forschungskatheders am Landwirtschaftlichen Institut. Charkoff.
Prof. A. F. TUELIN. Staatsuniversität, Agrofakultät. Perm.
P. D. WARLIGIN. Grosser Tolmatschewsky pereulok, 18, w. 9. Moskau.
M. A. WINOKUROFF. Sibirien-Landwirtschaftliche Akademie. Omsk.
N. M. ZAITZEFF. Moskau. *omit; read:* M. N. SAYTZEFF.

Sweden.

Skogsbiblioteket. Experimentalfältet.
Kgl. Lantbruksakademien. Stockholm.

Lic. fil. GUNNAR ASSARSSON. Sveriges geologiska undersökning. Stockholm 50.
Prof. HELGE G. BACKLUND. Mineralogisches und Geologisches Institut der Universität. Upsala.
Lic. fil. GUNNAR EKSTROEM. Sveriges geologiska undersökning. Stockholm. 50.
GUNNAR GIOEBEL, c-o Dr. C. BARTHEL. Experimentalfältet.
Prof. Dr. fil. Henrik HESSELMAN. Djursholm.
Prof. SVEN ODÉN. Experimentalfältet.
Dr. fil. Hugo OSVALD. Docent. Svenska Mosskulturföreningen. Jönköping
Dr. G. TORSTENSSON. Haga Gard. Knifsta.

Czechoslovakia

Bureau pédologique du Conseil d'Agriculture. Directeur: Dr. R. JANOTA Jungmannova 32. Praha.
Zemedels'sko-technický referát expozitûry ministerstva zemedel'stva. Stefanovicova ul. 1. Bratislava.
Institut de l'Etat pour les recherches agronomiques. Matůškova 934. Bratislava.
Pedologische Abteilung des technischen Bureaus des Landeskulturrates für Böhmen. Praha, *omit, see* Bureau Pédologique du Conseil d'Agriculture.
R. N. Dr. F. ULRICH, Assistent Karlovy University, Albertov 6. Praha VI.
Ing. J. VALICEK, Inspecteur de l'Institut biochimique. Kvetna 19. Brno.

INTERNATIONAL COMMISSION FOR THE STUDY OF CHEMICAL FERTILISERS.

History.

One of the chief concerns of the International Institute of Agriculture is of necessity research relating to the use of chemical fertilisers in the world's agricultural production, to experiments, to the statistics of production and consumption of fertilisers.

This point of view did not escape the attention of the Permanent Committee of the Institute, and from 1912 it has instituted world-wide statistics for fertilisers : its decision to publish these researches on fertilisers regularly was sanctioned by the General Assembly in that year.

The first collection of statistics on fertilisers was received so well by the international agricultural world that it has since been necessary to publish two editions of it, the last in 1924.

His Excellency Don E. Villegas, Ambassador of Chili and Delegate on the Permanent Committee of the Institute, made a proposal in 1920 aiming at the organization of an international scientific investigation of the fertiliser question. This proposal found in Rome very favourable ground for its development, and the principle was immediately recognized.

In 1922, M. Villegas, made a very judicious report on the production and consumption of fertilisers, and he then developed the idea of instituting tests for fertilisers, which should be arranged between different countries, and made according to rigorously comparable, standardised, scientific rules.

M. Villegas' proposition could not fail to have definite results since he had at his disposal a body of experts working over the entire world, and composed of the whole of the Delegates of the Nitrate Producers of Chili. These delegates chosen by the Chilian Association from among the most competent persons on agronomic questions have been charged for many years with propaganda by experiment.

They have moreover, worked everywhere with a success of almost international renown.

To give real effect to these views, a meeting of the Chili nitrate delegates took place in Rome on the 11th September 1925 and on that occasion His Exc. DE MICHELIS, President of the International Institute of Agriculture, invited the delegates to a conference at the Institute (see Appendix I.) the foundation of an international investigation of all fertilisers being now laid.

The delegates recognizing the work of the International Institute of Agriculture and the interest of its programme, it was decided that the Association of Nitrate Producers of Chili should grant funds for prosecuting the researches. The Permanent Committee further decided to ask other groups to contribute also to the cost of this work.

The Permanent Committee of the International Institute of Agriculture decided to nominate an international Commission to carry out the programme of work planned. This scientific fertilisers commission is the first commission forming part of the Committee of international scientific researches created by the International Institute of Agriculture. The first meeting of the International Commission of fertilisers took place from the 9th to the 13th February, in Rome. It settled the details of the experiments and the observations to be made and planned a control of fertilisers (See Appendices to the report of that meeting).

M. DE SCAVENIUS, Delegate of Denmark, was appointed reporter on the fertilisers question to the General Assembly.

This delegate drew up a report very favourable to the proposed international agreement for fertilisers research. At the end of it he made a proposal whose aim was to keep the Permanent Committee in touch with the best qualified representatives of the large fertiliser producers, and of the agricultural consuming centres for mutual information, in fact with the entire agricultural world, regarding the most effective and approximate measures for facilitating and regulating the supply of chemical fertilisers.

M. DE SCAVENIUS justly remarked that various groups held similar views and that it would be easy to get them to collaborate.

"Obviously", he added, "the best basis for this organization is the International Institute of Agriculture, since one of its principal objects is the encouragement of every kind of progress in agricultural industry and at the same time the Institute remains perfectly impartial to conflicting private interests".

The General Assembly, on M. H. DE SCAVENIUS' report, was called upon to take the following decision :—

" The General Assembly, having considered the report of M. DE SCAVENIUS, delegate for Denmark, expresses its satisfaction with the measures taken to give effect to the decision of the General Assembly regarding questions on the supply of chemical fertilisers, recognizes the importance of the researches indicated in the above-mentioned report and especially of the action taken to unify the researches and experiments on fertilisers.

Charges the Permanent Committee to see that the personel of the Institute concerned shall take steps for the quickest possible realization of the programme arranged ".

These resolutions were passed by the General Assembly in 1926.

The international organisation for fertiliser research and for control of the fertiliser trade is therefore an accomplished fact since the first meeting in 1926 of the International Commission for chemical fertilisers, when the General Assembly of 1926 sanctioned the appointment of the International Institute of Agriculture as controller of the matter. Its aim will be to keep the best qualified experts of various countries in touch with one another and to continue fertiliser research according to methods fixed by common agreement, which alone can enable the science of chemical fertilisers to make rapid progress.

MEMBERS OF THE COMMISSION.

Germany : Prof. Dr. LEMMERMANN, af the College of Agriculture, *Berlin*.

England : Sir John RUSSELL D. Sc., F. R. S. Director Rothamsted Agricultural Experimental Station, *Harpenden*.

Austria : Dr. F. W. von DAFERT-SENSEL-TIMMER, sekt. Chef, Direktor der Landwirtschaftl. Chemischen Bundesversuchsanstalt, *Vienna*.

Belgium : Prof. M. A. GRÉGOIRE, Directeur de la Station agronomique de l'Etat, *Gembloux*.

Chili : M. Alejandro BERTRAND, Ingeniero Civili de Minas, *Paris*.

Denmark : Prof. Dr. Harald R. CHRISTENSEN, Statens Planteavls Laboratorium, *Lyngby*.

Spain : Prof. D. G. QUINTANILLA, Director of the Central Agronomic Station, *Madrid*.

Egypt : M. A. MOSSERI, Ex-President of the Institute of Egypt and Director of Agronomic Research of the Royal Society of Agriculture, *Cairo*.

United States : Prof. LIPMAN, Rector of New Jersey Agricultural College, President of the International Association of Soil Science, *New Brunswick*.

The International Commission for the Study of Chemical Fertilisers, 1st Congress, 9-13 February 1926.

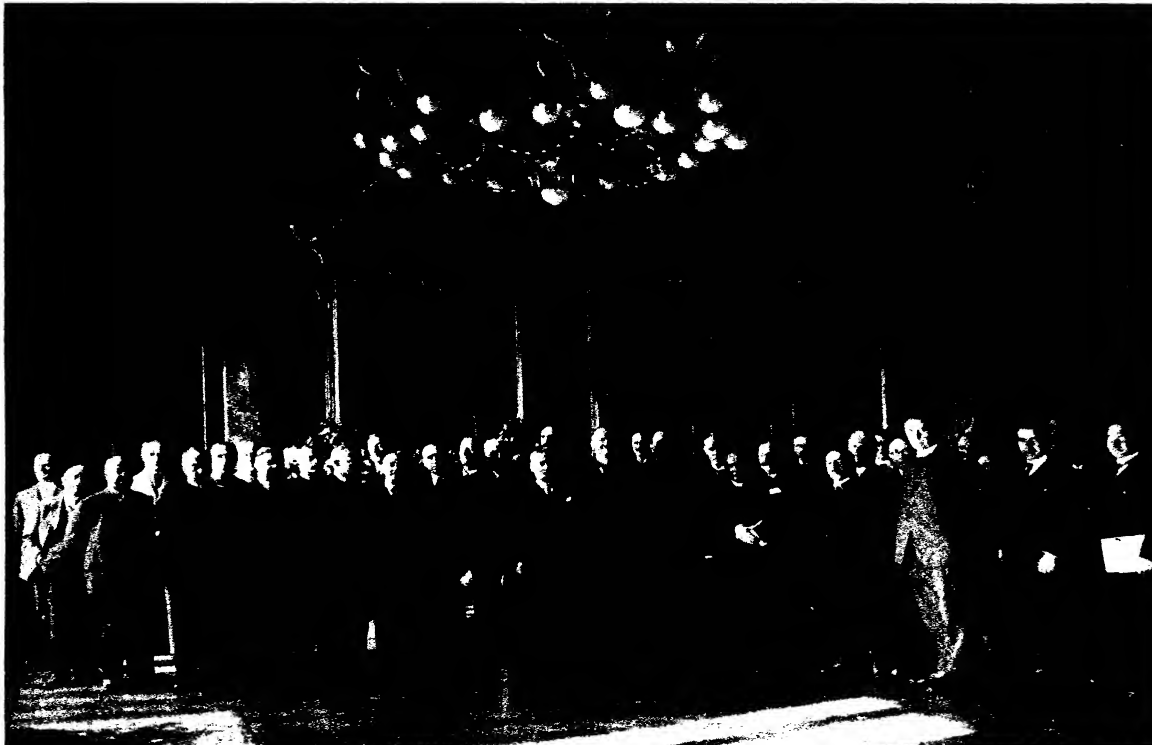

FIG. 101.—Members of the Permanent Committee of the International Institute of Agriculture. Members of the Commission. Representatives of Industrial Combines.

PLATE XXVIII.

The International Commission for the Study of Chemical Fertilisers 1st Congress 9-13 February 1926.

FIG. [illegible]. — Members of the Commission.

1. Prof. ABERSON. — 2. Prof. D. G. QUINTANILLA. — 3. Prof. C. A. H. V. FEILITZEN. — 4. Prof. O. LEMMERMANN. — 5. Prof. R. H. CHRISTENSEN. — 6. Prof. J. LENDE-NJAA. — 7. S. E. G. DE MICHELIS. — 8. Dott. G. A. R. BORGHESANI. — 9. Prof. M. A. GRÉGOIRE. — 10. Prof. J. JELINEK. — 11. M. A. BRUNO. — 12. Prof. R. CARDOSO. — 13. Prof. G. WIEGENER. — 14. Prof. C. DRAGONI.

Finland : Dr. JANNES, President of the Central Commission of Agricultural Experiments and President of the Federation of Agricultural Producers in Finland, *Helsinski*.

France : M. ROUX, Direuctur des Services Sanitaires et Scientifiques du Ministère de l'Agriculture, Represented by M. BRUNO, Inspecteur Général des Stations agronomiques, *Paris*.

Italy : Prof. Angelo MENOZZI, Director of the College of Agriculture, Represented by Prof. PRATOLONGO, *Milan*.

Prof. Ettore CARDOSO, Privat docent de chimie-physique à l'Université de Genève, libero docente all'Università di Roma, *Rome*.

Japan : Prof. SUZUKI, Faculty of Agriculture, Imperial University, *Tokio*.

Norway : Prof. J. LANDE-NJAA, Professor of the College of Agriculture and Director of the Experimental Station of Research on fertilisers, *Aas*.

Holland : Dr. D. KNUTTEL, Director of the Agronomic Station, *Maastright*.

Prof. J. H. ABERSON, Landbouwhoog school, *Wageningen*.

Poland : Prof. Emil GODLEWSKI, Agronomic Institute, *Pulawy*.

Russia : Prof. PRJANISCNICOF, Faculty of Agriculture, University, *Moscow*.

Sweden : Prof. Dr. C. A. H. von FEILITZEN, Director of the Central Station of Agricultural experiment, *Stockholm*.

Switzerland : Prof. Dr. WIEGNER, Professeur au Polytechnicum, *Zurich*.

Czechoslovakia : Prof. Dr. J. STOKLASA, Director of the Station of Chemistry and Vegetable Physiology, *Prague*.

Dr. Eng. Jan JELINEK, President of the provisional Committee appointed by the Congress of Warsaw for the coordination of Agricultural experiments, Agricultural and Forestry University, *Prague*.

Secretaries.

Dr. G. A. R. BORGHESANI, in charge of the Management of the Scientific Agricultural Bureau of the International Institute of Agriculture.

Dr. Luigi RAINERI, Delegate of the Association of producers of Chilian nitrate of soda.

PROGRAMME OF THE FIRST INTERNATIONAL COMMISSION FOR THE STUDY OF CHEMICAL FERTILISERS.

Opening meeting in the Salle des Réunions of the International Institute of Agriculture.

10 A. M. on the 9th February 1926.

Address by H. E. DE MICHELIS, President of the Institute.

On the necessity of scientific coordination of researches on chemical fertilisers.

Opening of the Conference.

Election of the President and nomination of Reporters and Secretaries of the Conference.

Order of busines.

Questions.

(1) Communications.

(2) Plan of international organisation for comparative tests of chemical fertilisers.

(3) Standardisation of experiments on chemical fertilisers.

(4) Control of the chemical fertiliser trade.

(5) Miscellaneous questions.

Meetings.

9th *February* 1926.

2 p. m. Commencement of business.

10th *February* 1926.

10 a. m. Continuation of business.
2 p. m. Continuation of business.

11th *February* 1926.

10 a. m. Continuation of business.
2 p. m. Continuation of business.
8.15 p. m. Banquet.

12th *February* 1926.

Business of Sub-Commission.

13th *February* 1926. 10. m.

Approval of proposals made by the Conference.
Close of business.

14th *February* 1926.

Excursion to Terni, inspection of electro-chemical works.

1st MEETING OF THE INTERNATIONAL COMMISSION FOR THE STUDY OF CHEMICAL FERTILISERS (9th-13th February 1926).

Opening meeting.

9th February 1926.

Provisional Presidency of H. E. Prof. DE MICHELIS, President of the International Institute of Agriculture.

The meeting commenced at 10 a. m.

The following members who were invited to attend the meeting were present :—

Germany : Prof. Dr. LEMMERMANN, Landwirtschaftliche Hochschule, *Berlin*.

Austria : Dr. F. W. v. DAFERT-SENSEL-TIMMER, Sekt. Chef, Direktor der Landwirtschaftl. Chemischen Bundesversuchsanstalt, *Vienna*.

Belgium : Prof. M. A. GRÉGOIRE, Directeur de la Station Agronomique de l'Etat, *Gembloux*.

Denmark : Prof. Dr. Harald R. CHRISTENSEN, Statens Planteavls Laboratorium, *Lyngby*.

Spain : Prof. D. G. QUINTANILLA, Director of the Central Agronomic Station, *Madrid*.

France : M. BRUNO, Inspecteur général des stations agronomiques, *Paris*.

Italy : Prof. Ettore CARDOSO, privat docent de chimie-physique à l'Université de Genève, libero docente all'Università di Roma, *Rome*.

Prof. U. PRATOLONGO, representing Prof. MENOZZI, *Milan*.

Norway : Prof. J. LANDE-NJAA, Professor at the College of Agriculture and Director of the Experimental Station of Research on Fertilizers, *Aas*.

Netherlands : Dr. KNUTTEL, Director of the Agronomic Station, *Maastright*.

Prof. J. H. ABERSON, Landbouwhoogeschool, *Wageningen*.

Russia : Prof. PRJANISCNICOF, Faculty of Agriculture, University, *Moscow*.

Sweden : Prof. Dr. C. A. H. VON FEILITZEN, Director of the Central Station of Agricultural Experiments, *Stockholm*.

Switzerland : Dr. G. WIEGENER, Professor au Polytechnicum, *Zurich*.

Czechoslovakia : Dr. Eng. Jan JELINEK, President of the provisional Committee appointed by the Congress of Warsaw for the coordination of Agricultural Experiments, Agricultural and Forestry University, *Prague*.

Secretaries : — Dr. G. A. R. BORGHESANI.
Dr. Luigi RAINERI.

Present as guests :

Dr. Paul BERTRAM, representing the Chilian Nitrate Committee of London.

Prof. Dr. MARIANI, Deutsches Kalisyndikat, *Berlin*.

Regierungsrat JUST, Stickstoffsyndikat, *Berlin*.

M. GALLAND, Comptoir français de l'Azote, *Paris*.

Prof. MANVILLI, Société Commerciale des Potasses d'Alsace, *Mulhouse*.

M. T. H. CARROLL, B. Sc. British Sulphate of Ammonia Federation, *London*.

Ing. VOLPI, Ufficio Tecnico di Roma, dell'Ammonia Casale, *Rome*.

Gr. Uff. LAZZARINI, Società Egiziana Fosfati, *Alexandria, Egypt*.

Ing. TOMMASI, Direttore della R. Starione Chimico-Agraria Sperimentale di Roma.

Dr. Luigi RAINERI, Italian Delegate of the Association of Nitrate Producers of Chili.

Prof. Comm. BENASSI, Società Montecatini, Società per l'industria mineraria e agricola.

THE PRESIDENT OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE.

I must first of all thank the members of the Commission who have been good enough to accept the invitation of the International Institute of

Agriculture and have come to Rome to take part in the 1st international meeting for chemical fertilizer research.

I also thank all those, who so kindly honour the meeting with their presence, the guests and especially my friend Prof. BRIZI, who will share in our labours in his capacity of head of the office of the Minister of National Economy and Director General of Agriculture in Italy. I regret that His Exc. Prof. PEGLION, Under-Secretary of State for Agriculture, being absent from Rome is unable to attend the meeting to express the pleasure of the Italian Government at having now in Rome so important a Conference as that which we are now holding. He has sent me the following telegram :—

" His Exc. PEGLION, detained Bologna previous engagement, regrets being unable attend opening meeting international research chemical fertilisers. Charges me express Your Excellency hearty thanks for kind invitation and his cordial adherence to Congress. Wishes success to this timely initiative of the Institute. Sends through your kind agency his best regards to eminent persons assembled. Hopes to be present subsequent meetings. Signed: MICHELI, Private Secretary to the Under-Secretary of State for Agriculture ".

Having said this, allow me to emphasize that this first Conference of experts in the science of fertilisers is a fresh affirmation of the great work of coordination which our Institute has been charged with carrying out in the field of Agricultural sciences. The first step in that direction was made by the International Conference of Soil Science, which also was held here in 1924 ; another advance will be made by the Conference for seed control which is to be held at the Institute next year.

Thus, the action of our Organisation in the work of international coordination, follows the logical sequence of the factors of agricultural production :— soil, fertilisers, seeds, etc. It is in thus that the Institute, with the collaboration of all agriculturists in the world, desires to exercise the functions of international coordination of research in the field of agricultural science.

The importance and fundamental need of this function were already appreciated by the Institute in 1923, when our Scientific Bureau dealt with the question of standardisation of methods of agricultural experiments : so much so that our Permanent Committee, two years later, placed on the agenda of the next General Assembly the subject which constitutes the principal object of our meeting today. It is perhaps from this that the last Warsaw Conference has derived the idea of creating a Commission for the standardisation of agricultural experiments, the utility of which seem to me to have been anticipated by our work. The Institute considers that in this question, as in all others which will in future concern its action, the method of work should first be considered and subsequently the purely technical and scientific side of the problems brought before the Commission.

The method, for chemical fertilisers, as for the other fields of activity of the Institute, has already been clearly decided. The Institute constitutes an international scientific Council, of which your Commission is an organ. This organ, which we have formed by inviting to it eminent specialists of the international world, may be asked to collaborate either by

means of correspondence or by sessions convened as required, and of which our present meeting is the first.

The resolutions which will be passed by you, will come before the Permanent Committee of the Institute which, after having deliberated on them, will bring them, when necessary, before the General Assembly. The latter in turn will make them the subjects of resolutions which will be brought officially to the notice of the various Governments, which always attach the greatest importance to the decisions and wishes of the supreme organ of the Institute, seeing that it is the highest expression of the complete representation of agricultural interests in international affairs. Thus you see that the creation of the international scientific Council has made the Institute the shortest route by which scientific results may become the subject of official measures on the part of Governments.

Regarding the second point, namely the scientific side of the question, I do not venture to encroach on this delicate ground which I leave entirely to you as it is yours by right of knowledge.

* * *

For practical purposes we have prepared a programme of business as follows :—

— Plan of an international organisation for comparative tests of chemical fertilisers.

— Standardisation of experiments on chemical fertilisers.

— Control of the chemical fertiliser trade.

The first and second questions are closely connected because it is impossible to arrange an international plan of experiments on fertilisers except on the basis of standardised rules.

Of course this order of business is not imperative and you may modify it as you think fit.

Allow me to tell you simply that the question of the control of chemical fertilisers which stands third in this order of business is of exceptional importance.

Before the war, the special Commission of the International Congresses of applied chemistry, presided over by the eminent late lamented Prof. LUNGE of Zurich, dealt with this question ; but it is not yet quite ripe and requires preliminary study. It would be well, in my opinion, to refer it for examination by our Commission at a future session.

If however, I may go into some details, I should consider it expedient judging from preliminary study by the Institute, to fix first of all rules under which the experiments should be carried out as regards the proposed international plan of comparative tests.

In this matter, I think that it should be possible to arrive at definite conclusions on the following points :—

(1) Size of the experimental plots.
(2) Number of plots for each test.
(3) Distribution of plots in each test.
(4) Number of tests for each series of experiments.

(5) Fixation of types of soil for each series, so as to eliminate the variable soil factor.

(6) Fixation of climatic zones for each series, so as to eliminate the variable climate factor.

(7) Number of years or rotations of crops during which the tests should be repeated.

(8) Plant types to be chosen for the tests.

(9) Practical rules for the preparation of plots, and the management and collection of the results.

Ideas on these fundamental points once settled, the first step will already have been taken towards the standardisation of experiments which will serve also for other branches of agricultural sciences. At present, as regards the international plan of comparative tests of fertilisers a programme should be arranged, methods defined and organisation sketched.

We have first to deal with the use of nitrogenous fertilisers to which have recently been added the classic products, nitrate of soda, sulphate of ammonia, cyanamide of calcium and the whole series of synthetic nitrogenous products.

It is evident that at our period of agricultural progress, the use of nitrogenous fertilisers varies with various conditions and stages of production. Producers and consumers would be greatly benefited by the regulation of at least the chief nitrogenous products by official directions and standards.

The question of phosphatic fertilisers might then be broached and the form in which the principal produce, phosphate of calcium, might best be used could be exactly considered.

For potassic fertilisers the problem of the use of assimilable potassic silicates arises; Italy, among other countries, possesses immense deposits which are not yet worked.

Now for all experiments it is necessary to have at one's disposal special means and organisation.

I think, as the Permanent Committee of the Institute has expressed the wish and as the London Delegation of nitrate producers has shewn, that all producers for the reasons which I have mentioned, are greatly interested in those researches. There is, indeed, everything to gain from a scientific objective research for regulating the rational use of chemical fertilisers.

We shall arrange for a statistical coordination of the data in the technical department of the Institute. This will be issued in precise form in our *International Review of the Science and Practice of Agriculture*

I fear I have already spoken at considerable length: and therefore I hasten to open the labours of the first international conference on chemical fertilisers. In bidding you welcome, I express my most sincere wishes for a happy outcome from your meetings. These wishes, Gentlemen, are after all superfluous, on account of your world renowned competence, which is a sure guarantee that the science of fertilisers — essential interest of the agricultural world — will derive the greatest profit from your learned discussions. I now wish to invite you, in accordance with the provisional order of business, to elect a President and appoint the reporters and secretaries

of the Conference. Possibly however you would prefer to do so at this afternoon's meeting, when you will begin the practical part of the work to which you have been invited.

Dr. JELINEK (Czechoslovakia) proposed that the election of the President and the nomination of reporters and secretaries be proceeded with at the afternoon meeting, which would be at 3 p. m.

(*It was so decided*).

The meeting closed at 10.30 a. m.

Second Meeting.

Tuesday 9th February 1926 (afternoon).

Presidency of H. E. DE MICHELIS. *President of the Institute.*

The meeting commenced at 3.15 p.m.

On the order of business:

PRESIDENT. — I think it desirable to emphasize what I said this morning regarding the nature of the work of this Commission, namely that the Commission need not waste time in discussing the best means of obtaining a concrete realization of the conclusions which it is going to arrive at. That is the business of the Institute which has already determined its plan and possesses the necessary means.

What we ask the Commission to do is to give its attention to the technical and scientific side of the question, and we hope to get from it very precise and valuable conclusions. That is its appointed work and for that it is not necessary to consider the subsequent work of procedure, which can be reserved for another meeting, or for the competency of the Permanent Committee. A plenary meeting of the Commission and the audience, over which I shall have the honour of presiding will take place at the end of the conference and at that meeting your resolutions will be examined ; I shall then ask you to give me advice and put forward your suggestions regarding the best method which should be followed by the Institute to realize the programme of work which it has promised to carry out. We have before us an order of business which has been arranged in the following way :—

Questions.

(1) Communications.

(2) Plan of international organisation for the comparative tests of chemical fertilisers.

(3) Standardisation of experiments on chemical fertilisers.

(4) Control of the chemical fertiliser trade.

(5) Miscellaneous questions.

I retain the presidency for a further few minutes to ask you whether you agree to consider this as the programme of your labours, or whether you think any alterations should be made in it.

M. GRÉGOIRE considered that this order of business should be modified. The order of business goes immediately into details of execution,

while the general question of the direction and nature of experiments should be previously examined.

PRESIDENT. — General direction of what ?

GRÉGOIRE. — Of the manner of making the researches. At the present time, all over the world results are being published which are obtained under the most different conditions : but it is absolutely impossible to derive rules of a general kind from these results. In my opinion, the conditions under which experiments should be made should previously be examined, to enable a synthesis of results to be made, whence to deduce general rules. And at present we have not got to that point.

QUINTANILLA asked leave to make a concrete proposal with reference to the standardisation of experiments on chemical fertilisers.

PRESIDENT requested him to postpone his proposal until the meeting at which No. 3 of the order of business would be considered.

He then asked M. GRÉGOIRE to state his proposal precisely.

GRÉGOIRE expressed himself in the following terms :—

" It is a question of principle which I put forward so that it may be possible to obtain really practical results by the institution of scientific tests on experimental farms. This concerns the general direction to be followed, with reference to what has been done up to the present time but from which we have been unable to arrive at definite conclusions ".

He gave examples of experiments which have been made to prove that it is not possible to obtain conclusions of a general nature from these experiments, and he expressed the opinion that the question which he had just raised was of the greatest importance for the work of the Commission.

The PRESIDENT ruled that it was a question of a general nature the solution of which would affect the discussion of various subjects on the programme of business and he asked the Commission whether it considered that it should be previously discussed. As no one wished to speak further on the order of business, that order was passed.

LEMMERMANN. — On behalf of the Commission, heartily thanked the President of the Institute for the welcome he had here given to the experts of the Commission . He expressed the opinion that the programme of business contained extremely important points for agriculture and that the work which they were about to begin would be of great utility for international collaboration in view of the progress of science and agriculture.

Election of the President.

The President of the International Institute of Agriculture invited the Commission to elect its President.

Von FEILITZEN proposed that Dr. Jan JELINEK of the Agricultural and Forestry University of Prague should be appointed President.

(*Carried unanimously*).

Presidency of Dr. JELINEK, *President of the Commission.*

JELINEK assumed the Presidency and thanked the Commission for the confidence it had shown in him. He then invited the Commission to appoint the Vice-Presidents and Reporters.

On the proposal of M. FEILITZEN there were unanimously appointed:

Vice-Presidents : — Messrs CHRISTENSEN, BRUNO and LEMMERMANN.
Reporters :— Messrs CARDOSO, GRÉGOIRE and WIEGNER.

COMMUNICATIONS.

The PRESIDENT announced :—

that Sir John RUSSELL had sent his acceptance of membership on the Commission and placed himself at its disposal, while regretting that his engagements prevented his appearing in person and assuring it that he would be present at the next meeting ;—

that M. MENOZZI had written an enthusiastic letter, at the same time announcing that he could not be present owing to the state of his health. He hoped to be able to take part in the work of the Commission at the next meeting ;

that M. BERTRAND could not come on account of engagements but promised to collaborate in the work undertaken by the Commission ;

that Mr. LIPMAN of New York was also prevented from being presont but that he placed himself entirely at the disposal of the Commission, hoping to participate in the work of the next session ;

that M. SUZUKI had not yet written. It was hoped that subsequent communications would promise the participation of this most competent member in the work of the Commission :

that M. GODLEWSKI would take part in the work of the next session ;

that M. PRJANISCNICOF keenly desired to be present but had been prevented from doing so by the condition of his health ;

that M. STOKLASA was at present engaged at Prague, but accepted membership of the Commission, placing himself entirely at its disposal ;

that M. JÄNNES had not yet written ;

that M. ABERSON would arrive the following morning :

that M. MOSSERI could not be present on account of his engagements. He had carried out, in Egypt, a great work of standardisation and his valuable collaboration might be hoped for in the next session.

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II. PLAN OF INTERNATIONAL ORGANISATION FOR COMPARATIVE TESTS OF FERTILISERS.

III. STANDARDISATION OF EXPERIMENTS ON FERTILISERS.

GRÉGOIRE developed his proposal and, after making his excuses for having to speak extempore and slightly at random, he expressed himself as follows :—

The object of the meeting is to settle the general rules for the experiments that we may be able to make and thence to draw conclusions enabling us to forecast the future. This is the character of what we call scientific laws. To obtain these results we may support a general synthesis ; it

is therefore necessary to know the conditions under which the results are obtained.

That rule, which is of general application, leads us in all sciences to an absolutely determined type of experiment, which here is carried out on the experimental farm, where we can determine the conditions under which the results have been obtained. In experimental farms experiments can be proceeded with for years, so enabling us to take into account not only the principal but also secondary actions of chemical fertilisers.

If we wish to determine results in order to arrive at a synthesis, we must operate everywhere in the same way: we must use a farm which will enable us to specify clearly the conditions under which we operate; which will enable us to determine the influence of one plant on the others, because there are plants which explore the top soil and there are others which explore the lower part of the soil) and it is evident that the results under such conditions may be quite different from those of experiments made here and there at random.

There is also one more important fact to be considered. Agricultural soil, as we agriculturists call it, is an artificial soil, and it becomes more artificial as the progress and intensity of culture increases. It is most artificial in gardens. Our soil should be brought, from a practical point of view to a potentiality of productivity determined by the conditions of the market. The experimental farm enables us to determine the possibilities of improving the soil; enables us to bring the soil to different degrees of potentiality and to determine the means used, while experiments, as they are made at present have only a purely local value.

The proposal which I make is for a recognition that the most essential and the most perfect means of obtaining positive results is the experimental farm, which should be established, with all necessary equipment, in every region and country.

BRUNO. — I recognize the value of M. GRÉGOIRE's statements but should like to go a little further back. The experimental farm would give us results having empiric synthetic value, which may suffice for local requirements; but if we want to look clearly and scientifically into the matter, it would first of all be necessary to make various calculations.

The investigation of fertilising material should, in my opinion, start first of all by a theoretical study of the medium. It would so be possible, under theoretical conditions, to limit the number of factors and give room for agreement among scientists. I think that this research and control of fertilisers can only be begun by pot culture experiments. Some of my colleagues, and especially M. LEMMERMANN, could give us good advice on this subject.

In experiments in plots I doubt if we ought to pretend to results which are truly and strictly scientific. The number of factors which come into play in these cultural experiments is particularly large, and if that were all, it would not matter. But the fact is we do not know what it is, nor the number of factors concerned. There was a scientist who said that it was necessary to have all factors constant, except one which should be made to vary, in order to study the influence of this factor on the crops:

but the list of all the factors is unknown to us, and it is therefore almost impossible to apply a strictly scientific method ; a Cartesian method.

That being so, ought we to give up the idea of getting nearer to the truth ?

Experiments can only give us what they are capable of giving. Vainly the scientist investigates the conditions of the soil, its chemical, geological and other characteristics, there is always something beyond his grasp ; there is the climate factor ; there is the factor which the plants themselves contain ; there is the mystery of plants ; and then again accidental factors and disturbances, in short factors of such a nature that experiments, even when very well organised, cannot give results from a scientific point of view, unless an attempt is made to take the greatest possible number of factors into account. And then — and here, perhaps, I shall approximate to what our friend M. GRÉGOIRE has just said — I think that the experiments once organised should be followed not only by chemists, and agriculturists, but also by botanists who can observe the plant, and see if it grows in a regular manner ; and I would call in the physicist go note the variations of climate ; the plant pathologist to see whether the plants in the various plots keep healthy ; I would even call in the entomologist who would see whether some insect is not troubling the plant, not only the foliage but also the roots. I would also hold a medical examination to see if the plants were healthy or if they suffered from parasites. In short, a sort of sanitary inspection would be required in which not only the physical and chemical but also the biological conditions might be noted. In this way the experiments would have great value and they could be compared one with another. When potato tubers are planted, there are some plots which do well and others not well. It is no use being a good chemist ; it is impossible to get at the truth ! I think that tests on the ground should be carried out with the cooperation of agriculturists, chemists, biologists of various types and physicists. Ten experiments so made would be worth much more than a hundred such as are commonly seen.

QUINTANILLA thought that a clear distinction should be made between moist and dry climates, because he had had the opportunity of noting that, according to those conditions, experiments with chemical fertilizers gave very different and sometimes even contradictory results.

He had made experiments during four years on numerous plots and he had been able to determine differences which were due to the depth of soil and the rainfall of the previous year, which had convinced him of the great importance of this factor, which should be taken into consideration in these experiments.

GRÉGOIRE, further developed the conditions under which the experiments should be made. It was necessary to consider different districts of countries, the different nature of the soil, etc. and to establish an experimental farm in each district. He referred to what had been done in this respect in the United States and Germany and again maintained that the experimental farm was the only means of arriving at positive results. He concluded by proposing that the Assembly should recommend to all

countries the establishment of esperimental farms as the basis of the experiments.

LEMMERMANN remarked that the question of chemical fertilisers varied greatly in different countries. He found it very desirable to establish experimental farms, but thought that the realization of such a proposal was fraught with very considerable difficulties.

In the first place, if international agreements were desired, it would be necessary to know what tests could be made uniform from an international point of view ; next agreement must be reached on the method of making these tests, and finally the questions for consideration would have to be settled.

WIEGNER. — As far as Switzerland was concerned, he found that it was impossible to establish experimental farms such as those conceived by M. GRÉGOIRE. Regions with homogeneous characters might perhaps be found in larger countries, but they would not be found in Switzerland, where differences of soil and climate were very considerable in a single region.

GRÉGOIRE insisted on his proposal, for he was certain that otherwise satisfactory conclusions could not be reached. If the conditions of the soil in which the tests were made were not homogeneous, there was no fixed starting point whence to arrive at conclusions of a scientific and general character.

He thought, moreover, that even in Switzerland — if there were regions, such as the Engadine, where conditions were really very difficult for the establishment of an experimental farm — there were however others where it would be possible to establish them.

LEMMERMANN. — Agreed with M. WIEGNER as regards soil conditions, and he remarked that, even in Germany, there were great differences in the constitution of the soil. For this reason he thought that these tests could not always give good results. All the same he thought that the tests ought to be made and that comparisons would be possible, even in cases where variations in the soil were very considerable.

Von FEILITZEN, said that experiments on experimental farms were the business of the scientist ; but for practical use what was wanted were experiments on ordinary fields, multiplied as much as possible.

GRÉGOIRE. — Agreed as regards practical farming ; but, as they were now dealing with a scientific question, he thought that if they so limited the tests centuries would be spent without anything of sure and general scientific value being accomplished. He said that he had followed the publications which had been issued in Germany on mass experiments and that he doubted very much whether it was possible to deduce from all of them anything more than data of purely local value : data of use to agriculturists but without scientific finality.

PRESIDENT. — Expressed the opinion that the experimental farm ought to be the scientific station in which unknown principles were sought for. Afterwards, when information had there been collected, they ought to try to make large scale tests. But in order to succeed in establishing settled points, experiments would be necessary for several years to enable

the experimenter to get his bearings on the question involved. In the nature of things they could not stop at the question of the experimental farm.

GRÉGOIRE. — Remarked that it was a question of application ; but if rules were to be determined in a general way the question of experimental farms must arise : and this was especially the case in countries where they had none. In Belgium he was certain that experimental farms would give results holding good for all regions in which they were established.

WIEGNER. — Insisted that the variations of soil and climate were so great that, in his opinion, it was impossible to think of making an experimental farm based on homogeneous conditions.

CHRISTENSEN. — Said that the really important question was that of the standardisation of experiments, which was not a question of experimental farms, but a question of local tests made in great numbers.

BRUNO . — Remarked that, at the present moment, it must be recognized that the idea of organizing experimental farms was only accepted with considerable reserve. Moreover, if it was wished to form experimental farms, they must be very well done, otherwise it was better not to attempt them. A public institution, especially, should not set a bad example. If experimental farms were made they must make an effort to provide them with good working stock, to place good agriculturists in charge of them and to establish them in uniform regions. Given these condition good results might be obtained.

But he did not believe that these results would hold good for adjacent farms, because they would be due to the personal activity of the man in charge of the experimental farm, who would be absent from the adjacent farm.

Moreover, the establishment of numerous experimental farms in various countries would involve considerable expenditure without a corresponding return.

He described attempts made in France, cautions though they were and made with limited means.

They were proposing to carry out researches in the agricultural stations in order to establish scientific facts in relation to the climate and soil conditions.

When the agricultural station thought it possible to formulate a proposal, it was a question of seeing whether the culture should be started at once, and, as that might be dangerous, the creation of experimental farms was thought of, which would have the object of verifiying from a practical point of view the results of the agricultural station by tests. The experi mental farm, in short, should serve as intermediary between the work of the agricultural station and practical farming. If good results were not obtained on the experimental farm, the question would be further investigated. If the tests gave favourable results, it was a question of instigating the growers to put into practice the proposition which it was wished to make general. It was then a matter of propaganda in which they would have the help of the companies who sold chemical fertilisers.

But in accordance with the programme drawn up by the Institute for

the Commission, it seemed to him that the work of the Commission should be limited to matters of research, that is to say to agricultural stations.

QUINTANILLA. — Put forward the following proposal :—

« I propose that a small commission be appointed to fix the principal points and the conditions to which the experiments must conform to keep pace with the results of tests of those fertilisers which principally concern agriculture, setting aside the question of scientific study in the laboratory and regulating the conditions of experiments, which should be carried out on a semi-industrial scale at least, so as to resemble as closely as possible ordinary field conditions ".

Presidency of Prof. LEMMERMANN.

M. JELINEK. — Remarked that the same discussion which had just now taken place had occurred at the last Warsaw Congress at which an international coordination of experiments concerning cultural varieties, tests and analyses of fertilizers was desired. He recalled the wish expressed at the conclusion of that Congress and the appointment of the Commission of which he had the honour of being President.

All the discussion which took place at Warsaw and here related to the elaboration of a common work, of a method for unifying tests and the publication of the results obtained. He recalled what the President of the Institute said and the following points on which he said that precise conclusions could be arrived at :—

(1) Size of the experimental plots.

(2) Number of plots for each test.

(3) Distribution of plots in each test.

(4) Number of tests for each series of experiments.

(5) Fixation of types of soil for each series, so as to eliminate the variable soil factor.

(6) Fixation of climatic zones for each series, so as to eliminate the variable climate factor.

(7) Number of years or rotations of crops during which the tests should be repeated.

(8) Plant types to be chosen for the tests.

(9) Practical rules for the preparation of plots, the management and collection of data.

CARDOSO. — Found Prof. JELINEK's proposal very interesting. He thought, however, that M. QUINTANILLA's proposal came into the programme of present work though of a different nature.

QUINTANILLA, proposed to form a small internal Commission which should immediately indicate to the Commission proper the method of conducting the experiments. Prof. JELINEK's proposal concerned a later time.

GRÉGOIRE. — Thought M. CARDOSO's remarks correct and that Prof. JELINEK's and M. QUINTANILLA's propositions were two different proposals, each to be examined in turn.

BRUNO. — Thought that the question put forward by M. JELINEK

might come under Nos. 2 and 3 of the programme of business and that at present the proposal of M. QUINTANILLA might be considered.

JELINEK and CARDOSO agreed with this.

PRESIDENT. — Asked if the Commission wished to appoint the small Commission at once.

GRÉGOIRE. — Proposed that the small Commission should be composed of Messrs BRUNO, QUINTANILLA, JELINEK, LEMMERMANN and WIEGNER.

THE PRESIDENT. — Put this proposal to the vote and it was unanimously approved.

The meeting ended at 5.30 p. m.

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Third meeting.

Wednesday 10th February 1926 (morning).

Presidency of Dr. JELINEK.

The meeting commenced at 10.15 a. m.

THE PRESIDENT. — Announced that the sub-commission which was appointed on the previous day had examined, in all its details, question No. 3 on the programme of business, " Standardisation of experiments on chemical fertilisers " and put forward 11 points as a basis of discussion. He asked M. BRUNO to read them out saying be would have them discussed point by point.

BRUNO. — Read out the 1st point :

(1) *Soil* ..... Choose a soil as uniform as possible, and test it by a sufficient number of borings ; arable layer ..... cm., subsoil ..... cm. Avoid ground with a steep slope, especially in not very permeable soil. If a sloping ground has to be used mark out rectangular plots elongated at right-angles to the run of the valley.

PRESIDENT. — Opened the discussion on this point. As no one wished to speak, he declared it adopted.

BRUNO. (2) — *Shape of the plots.* Be guided by the possibilities of the ground and other local conditions for marking out square or rectangular plots.

He remarked that the Commission had not wished to make a pronouncement on the choice of the square or rectangular shape as it considered that this might be left to the discretion of each person according to the local conditions.

PRESIDENT. — Ascertained that all were agreed on this second point and declared it adopted.

BRUNO. (3) — *Area of the plots.* Give each plot a minimum area of 25 sq. m. and a maximum of 100 sq. m.

(*Adopted*).

(4) — *Number of plots* — Repeat the same test at least 5 times and have at least 5 control plots.

(*Adopted*).

(5) — *Distribution of the plots* — Distribute them as well as possible according to the dimensions and lie of the ground

GRÉGOIRE. — Was of opinion that it would be better to use the word "uniformly" instead of the phrase "as well as possible".

BRUNO. — Explained that the Commission had examined various possibilities for the distribution of plots ; first of all the Norwegian method which consists in placing one control plot, two plots, one control plot, two plots, ... then the method of distributing the same plots in a central part of the ground ; it had also considered the recommendation of certain statistics of indicating the plots by letters or numbers and distributing them at random. And finally the Commission considered that it is not always convenient to have a very large uniform ground, which may be square, elongated, etc. and that it was best to leave it to each person to make the best distribution possible.

GRÉGOIRE. — Insisted on his proposal to use the word "uniformly" which seemed to him more precise.

PRESIDENT. — Ascertained that there was no opposition to the modification proposed by M. GRÉGOIRE. He therefore declared point 5 approved with the substitution of the word "uniformly" for the words "as well as possible".

BRUNO. (6) — *Paths between the plots* — The plots should be contiguous, except for leaving a path, in a single direction, 50 cm. wide between every second plot to facilitate cultural operations and inspection. Seeding to cover uniformly the whole surface of the plot. For harvesting plants on a width of 50 cm. inside the boundaries of each plot are first of all removed. The experiments are therefore always separated from each other by a distance of one metre on three sides and by 1 m. 50 on the side of the path.

(*Adopted*).

(7) — *Duration of the tests*. — Continue the testing of the same areas during 5 years on successive crops.

(*Adopted*).

(8) — *Characteristics of the soil and climate*. — Note them and publish them with the results :— *Soil*, locality — depth — analysis. *Climate*, temperature — humidity — rain — nebulosity.

LEMMERMANN. — Proposed to add to this point that these analyses should be carried out in accordance with the method which would be determined by the International Commission for soil science.

CARDOSO. — Thought it would be well to add as regards meteorological observations, "actinometric degree", before "nebulosity", which seemed to him a very important factor.

QUINTANILLA. — Was of opinion that the amount of rain and the number of wet days should be added.

PRATOLONGO. — Thought hat the duration of sunshine should be determined.

GRÉGOIRE. — Explained that this was done at Gembloux by means of a very simple and easily handled instrument.

BRUNO. — Considered that it was not desirable to go into details to avoid imposing obligations which could not be complied with everywhere.

CARDOSO. — Agreed with M. BRUNO not to introduce measure factors which would complicate the results ; he thought, however, that it would be useful, as M. PRATOLONGO said, to determine the duration of sunshine, but on condition that a very simple apparatus was used which would give the factors :— intensity and duration ; and that very simple and easily handled apparatus could be purchased.

von FEILITZEN. — Thought that it would be sufficient to say that the meteorological observations should be made in each State in accordance with the official methods, and that the Commission would be going outside its business in giving details of a meteorological kind, which belonged to the province of other groups of persons. In the same way regarding the proposal of Prof. LEMMERMANN to adopt for the analysis of the soil the method which would be prescribed by the international commission of pedology, they might also refer to specialists on the subject. Consequently he was of opinion that by the word " actinometry " they could include everything without going into details.

QUINTANILLA. — Was of opinion that it was not desirable to prescribe the method of the international Commission of pedology, which might only suffice when much propaganda and several tests of the method itself had been made. Consequently he thought it best not to refer to the method of the Commission of pedology but merely to give general instructions.

PRESIDENT. — Proposed that in order to find a formula reconciling all these points of view, point No 8, should be sent back to the Sub-Commission for supplementary examination.

(*This proposal was adopted*).

BRUNO. — (9) — *Plants used.* Always use well tested seeds, indicate their quality, the density of sowing. State very precisely the variety and origin.

(*Adopted*).

(10) : — *Remarks on growth.* Note the essential facts of growth, their dates. Attacks of diseases or of parasites. Weeds. Treatments applied. Casualties or damge caused by meteorological factors or fortuitous.

GRÉGOIRE. — Thought it necessary to specify here the conditions under which the spreading of the fertilisers and the sowing of the seeds should be done. He added that there were mechanical means for this.

BRUNO. — Said that this had been overlooked by the Sub-Commission. He remarked that it was difficult to determine conditions for the even spreading of the fertilisers and the even sowing of the seeds ; and he did not know whether mechanical means existed. Nevertheless M. GRÉGOIRE might draw up a short proposal which the Sub-Commission would examine.

PRESIDENT. — Ascertained that no one opposed this. M. GRÉGOIRE would therefore draw up his proposal which would be handed to the Sub-Commission.

Point 10 *was adopted.*

BRUNO. — (11) :— *Crop.* The whole crop of each plot should be weighed after drying under shelter when this is possible especially with the use of small plots (25 sq. m.). When large plots (100 sq.m.) are used it becomes necessary to take a sample of each plot for drying under shelter, weigh it, and make the necessary examination of it. In this case the method adopted should be indicated.

CARDOSO. — Did not know whether these details should be gone into, but it would be useful to specify the weather conditions during the drying.

GRÉGOIRE. — Thought that the most precise method was that of WAGNER, which consists in weighing the crop immediately, taking a sample of the crop, drying it and determining on the product obtained the content in dry matter : in this way absolutely certain figures were obtained.

PRATOLONGO (representing M. MENOZZI). — Remarked that there were two methods :— WAGNER's and that of the Commission. He recognized that WAGNER's method of weighing the whole crop was the better but it was also more difficult. Consequently he would suggest not going into details, or else indicating both methods.

GRÉGOIRE. — Was of opinion that WAGNER's method, which had the great advantage of simplifying the work, should be adopted. At harvest time agricultural labourers were at full strength on the farm and the work could be done quickly, whereas a considerable number of plots meant difficulty in handling.

LEMMERMANN. — Considered that it was indispensable not only to weigh the green crop but also always to determine the dry matter.

BRUNO. — Proposed that in order to take into consideration the observations which had been put forward point 11 be sent back to the Sub-Commission for another indication aiming at the result in dry matter according to the most appropriate method.

(M. BRUNO's *proposal was adopted*).

GRÉGOIRE. — Remarked that the 11 points which had been submitted to the Commission did not affect the question raised of experimental farms, which in his opinion was very important, even fundamental as experiments in detail could never give complete results, for which the experimental farm with a wide area was indispensable. He consequently asked that the Commission should come to a decision on the following proposal which he had the honour of submitting to it :—

" The Commission considers that the most certain means to put in action for the integration of scientific data concerning chemical fertilisers is the creation for each agricultural region of experimental farms with a plan of action extending not only over fertilisers, but also over work ".

PRESIDENT. — Announced that this proposal would also be submitted to the Sub-Commission He then remarked that they had at present to discuss the question " Plan of international organisation for comparative tests of chemical fertilisers " and he asked whether the Commission wished to have a general discussion or to refer the question at once to the Sub-Commission which would prepare the basis of the discussion.

(*It was decided to refer the question to the Sub-Commission*).

PRATOLONGO. — Desired to call the attention of the Commission to 2 points which he had not seen dealt with in the Sub-Commission's report, namely that of the analysis of the fertilisers.....

PRESIDENT. — Said that this would come later.

PRATOLONGO. — The other point concerned a rule in order to understand whether the experiment were conclusive or not. He thought it would be useful to determine this by statistical means. This was a recommendation which he wished to make to the Commission.

CARDOSO. — Remarked that M. BRUNO in his very precise and clear statement of the previous day had spoken of the collaboration in these experiments of scientists of various branches of science, chemists, botanists, phytopathologists, etc. and he asked whether it would not be well for the Commission to express the wish that these experiments should be followed by scientists such as M. BRUNO indicated. That would permit of an infinitely better control and the obtaining of results which could be discussed with greater exactness. As regards the standing of these scientists it was a matter for discussion ; he asked that in the first instance the principle should be admitted.

BRUNO. — Said that the Commission in its note had implicity accepted the principle of control by specialists, and he wondered if it was necessary to say so more precisely. He thought that collaboration was extremely desirable and everyone was agreed on this point, but he did not know that it was necessary to make a hard and fast rule which might be an obstacle. to certain experiments. In any case, the Sub-Commission might also examine this point.

(It was decided to refer his proposal also to the Sub-Commission).

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Fourth meeting.

10[th] February 1926 (afternoon).

Presidency of Prof. JELINEK.

The meeting commenced at 3.30 p. m.

PRESIDENT. — Announced that the Sub-Commission had accomplished its task and that it had changed its recommendations in some points, consequent on what had been said in the morning meeting.

BRUNO. — Read the new text.

Nos. 1 to 6 remain without any alteration.

1. *Soil.* — Choose a soil as uniform as possible, and test it by a sufficient number of borings, arable layer ..... cm. subsoil ..... cm. Avoid ground with a steep slope, especially in not very permeable soil. If sloping ground has to be used mark out rectangular plots elongated at right-angles to the run of the valley.

2. *Slope of the plots.* — Be guided by the possibilities of the ground and other local conditions for marking out square or rectangular plots.

3. *Area of the plots.* — Give each plot a minimum area of 25 sq. m. and a maximum of 100 sq. m.

4. *Number of plots.* — Repeat the same test at least 5 times, and have at least 5 control plots.

5. *Distribution of the plots.* — Distribute them uniformly according to the dimensions and lie of the ground.

6. *Paths between the plots.* — The plots should be contiguous, except for leaving a path, in a single direction, 50 cm. wide between every second plot to facilitate cultural operations and inspection. Seeding to cover uniformly the whole surface of the plot. For harvesting plants on a width of 50 cm. inside the boundaries of each plot are first of all removed. The experiments are therefore always separated from each other by a distance of one metre on three sides and by 1m. 50 on the side of the path.

After No. 6 has been added a No 6 (*a*) worded as follows :—

6. *a*). *Distribution of the fertilisers.* — The fertilisers should be applied accurately and regularly, special attention being given to the application of farmyard manure. Each fertiliser should be applied at the most suitable time for good effect, in one or several applications.

(*Adopted*).

To No. 7 which was worded as follows :—

Duration of the tests. Continue the testing of the same areas during 5 years on successive crops, it was proposed to make a small modification.

Instead of " 5 years " should be substituted " at least 5 years ".

(*Adopted with this modification*).

No. 8 has been slightly modified :—

8. *a*) *Composition of the fertilisers.* — Always give precise indication of the fertilisers used :— nature, origin, fineness, complete chemical analsis, and eventually petrographic or microbiological characters.

(*Adopted*).

Nos 9, 10, have not been altered :—

9. *Plants used.* — Always use well-tested seeds, indicate their quality, the density of sowing. State very precisely the variety and origin.

(*Adopted*).

10. *Remarks on growth.* — Note the essential facts of growth, their dates, attacks of diseases or of parasites. Weeds. Treatment applied. Casualties or damage caused by meteorological factors or fortuitous.

(*Adopted*).

11. *Crop.* — It is recommended that the results should always be expressed in air-dried matter and in dry substance (constant weight at 100°).

GRÉGOIRE. — Remarked on No 11 that they might be content with the determination of the density, for the system recommended here was very lengthy and could only be recommended for laboratoy experiments.

BRUNO. — Said that this proposal was rather ideal and it had been made to define clearly what they wished to expect.

GRÉGOIRE. — Insisted, saying that experiments had been made in Belgium with both methods ; the results agreed very closely but the density method was infinitely quicker.

PRATOLONGO. — Thought that it sufficed to strike out the words

"constant weight at 100°" and leave the chemists to arrange as they thought best.

(*Adopted with this elimination*).

11 (*a*). *Experimental error.* — The experiment will be considered as demonstrative when the differences of the averages results obtained are less than double the probable error.

GRÉGOIRE. — Asked that it should be clearly defined how the probable error was to be calculated. It might be defined with the second power, or else with the first power and for his part he was convinced that the definition could be done in either case with equal certainty. But when the second power was taken large differences greatly influenced the value calculated.

PRATOLONGO. — Thought that they were two identical values and that moreover, such details ought not to be gone into.

QUINTANILLA. — Agreed with M. PRATOLONGO.

GRÉGOIRE. — Insisted that the differences were greater if the calcula tion was made with the second power. He thought that the calculation with the first power was more exact and more convenient.

PRESIDENT. — More convenient, yes ; but not more exact.

GRÉGOIRE. — Did not think, moreover, that it was a case of a negligible detail. As a basis was taken, it was expedient to settle how the basis ought to be calculated.

CARDOSO. — Wondered whether the experiments were sufficient for this calculation. It was necessary to use a formula ; that formula depended on theoretical ideas implying a fairly large number of observations. Did that number exist ? He did not think so.

GRÉGOIRE. — Assured him that many results had already been obtained so that he thought that after 5 tests the formula could be used.

BRUNO. — Thought that it was not necessary to be too particular about being precise.

GRÉGOIRE. — For his part found that it was necessary to state the starting point precisely in order to reach a conclusion. He insisted in his proposal that it should be stated that the probable error must be calculated with the first power.

PRESIDENT. — Put the Commission's proposal to the vote and it was approved.

11 (*b*). *Experimental Farms.* — The Commission considers it advisable to establish an experimental farm in each natural region, subject to the direct control of laboratories of the various departments cooperating in the improvement of agriculture.

IV. — CONTROL OF THE CHEMICAL FERTILISER TRADE.

BRUNO read the following decision of the Sub-Commission :—

The Commission considers it impossible, in a short time, to reach an international agreement for unifying the methods of fertiliser analysis.

It thinks it possible to recommend, for international transactions, unification of the method of expressing results of analyses namely :—

for nitrogenous fertilisers, expression in nitrogen, N and not NH_3 per 100 kilogrammes, the form of the nitrogen to be indicated.

for phosphatic fertilisers, expression in P_2O_5 and not in tricalcic phosphate, with indication of solubility in special reagents.

for potash, expression in K_2O, and solubility in water, or in a reagent of indicated composition.

The figures given must be accompanied by an indication of the method of analysis used.

GRÉGOIRE. — Considered that there is a term which should be extended to international language, namely that of cyanamide and cyanamidic nitrogen.

BRUNO. — Thought that M. GREGOIRE's proposal deserved to be thoroughly examined because, perhaps, the term "dicyanamidic" ought to be included.

PRATOLONGO. — Said that a single group ought to be formed of cyanamidic and dicyanamidic nitrogen because it was organic nitrogen in each case.

BRUNO. — Feared that the Commission might be involved in a very lengthy discussion. Cyanamide was not only sold in a natural state but also in other substances, and the Sub-Commission was unable to take into consideration terms on which it was not very well informed. Perhaps the question would make progress before the next Conference and then it might be possible to see the matter more clearly.

The term which M. Gregoire proposed to indicate. included a certain number of things which have a certain relationship but which are not identical. They could say, at present, "nitrogen derived from cyanamide".

GRÉGOIRE. — Thought that his proposal ought to be adopted in order to obtain a certain uniformity of language. He insisted that greater precision of language must be reached and said that, in Belgium, many terms were obligatory for merchants in their invoices, by authority of a royal decree.

QUINTANILLA. — Proposed to appoint a Sub-Commission for dealing with the question which was No. 4 of the programme of business, for he considered that it would not be easy to arrive at concrete and positive conclusions by discussing it in a plenary conference.

PRESIDENT. — Put this proposal to the vote.

(*Adopted*).

He proposed that the Sub-Commission be composed of Messrs. Von FEILITZEN, GRÉGOIRE, BRUNO, LEMMERMANN and QUINTANILLA.

(*Adopted*).

V. MISCELLANEOUS QUESTIONS.

PRESIDENT. — Announced that M. LEMMERMANN had put before the Commission the following proposals on the Control of the chemical fertiliser trade.

They were as follows :—

(1) In the first place, it is necessary to determine by a *definition* what substances should legally be called "fertilisers". In that definition

should be comprised all preparations which are offered to the agriculturist, often indirectly, as fertilisers, for example, bacterial preparations, means of soil improvement, irritant substances (radioactive substances), etc.

(2) The denomination of fertilisers should indicate clearly their nature, they should not therefore bear fantastic names, such as :— Universal fertilisers, concentrated fertilisers.

(3) The vendor should indicate precisely the fertiliser's content in substances affecting its value and guarantee the content indicated.

(4) Precise figures should be fixed for admissible deviations relative to the guaranteed content (errors of analysis, margin.)

(5) The method of taking samples should be regulated and also it should be determined whether, in case of dispute, the sample taken from the vendor or that taken from the buyer should be taken as evidence.

(6) It should be determined what laboratories have the right of testing fertilisers :—

Whether only (1) State institutions,

Or also (2) Private laboratories.

In any case, if there is a dispute the decisive analysis should only be made in an official laboratory.

(7) It would be desirable to forbid the sale of fertilisers other than those approved by the State.

(8) The methods of analysis according to which analyses of fertilisers may be made should be determined.

(9) It would be desirable that these same rules should apply to international trade. For example, Chili saltpetre is analysed in certain countries by the direct method, in others by the indirect method ; superphosphate is analysed in some countries according to the P_2O_5 content soluble in water, in others according to the P_2O_5 content soluble in alkaline citrate of ammonia, etc.

As M. LEMMERMANN asked that his proposals might be distributed so that all members of the Commission could think them over, he asked the Vice-President of the Institute whether — since these proposals could not be considered sufficiently ripe for deliberation — the procedure could be adopted of requesting the Institute that they might be placed on the programme of business in the next session.

PRESIDENT. — The Sub-Commission which we have appointed will recommend the Commission to request the Institute to distribute these proposals among all members so that they may be able to give their opinions in the future.

BRUNO. — We have here a basis for discussion formulated in writing by M. LEMMERMANN. They are clear, distinct, precise proposals : some of them will certainly not be accepted, and even M. LEMMERMANN is under no delusion in this respect : some of them will be accepted with modification. But certainly, there is in them a basis for discussion. Therefore, in order that everyone may be able to think them over and give their opinions at the next session, these proposals should be distributed.

PRESIDENT. — I have here a communication by M. von FEILITZEN.

von FEILITZEN. — Read in English the communication printed in Appendix II. 3.

The meeting ended at 6 p. m.

The members of the Commission were convened to a meeting reserved for them next day at 10 a. m.

Fifth meeting.

Thursday 11th February 1926 (morning).

Presidency of DR. JELINEK.

The meeting commenced at 10.30 a. m.

H. E. Prof. DE MICHELIS, President of the Institute was present at the meeting.

PRESIDENT welcomed H. E. DE MICHELIS who had come to the meeting.

H. E. DE MICHELIS, President of the International Institute of Agriculture addressing the members said that, with Messrs. JELINEK and BRUNO, he had examined the suggestions which had been made on the subject of the method of business to be adopted for the next meetings of the Commission. And it had been decided — subject to the approval of the Permanent Committee of the Institute, an approval which he thought he could at once say would be accorded — that the convocation of the Commission would take place a short time before the date of the conference ; that the programme would be sent in advance to the Members of the Commission to make modifications in it which they might suggest ; that the reporters, at any rate for the principal questions, would be appointed in advance, so that in the meeting of the Commission there would already be some members who would have thoroughly studied the subject under examination ; that these reports and the office reports would be typed and sent to the members of the Commission as quickly as possible and at least a week in advance. He concluded by saying that if any one had any proposals to make on the subject of the work of the Commission they might be examined at once.

PRESIDENT of the Commission ascertained that no one wanted to speak on that subject ; consequently the method of business explained by the President of the Institute was adopted.

PRESIDENT OF THE INSTITUTE then spoke as follows :—

" I do not know whether you have an exact idea of the organisation given to your international scientific council. The Institute wished to fortify itself with the advice, direction, the scientific and technical guidance of an international body composed of scientists and experts ; and as it might have been difficult to deal at once with the constitution of a large organisation of this kind, it determined to proceed by stages and began by creating these international scientific councils, each composed of authorities recognized by all countries as scientists whose opinion was worth listening to. It has thus created the Commission for chemical fertilisers, to which you all belong and which will be the nucleus of our Council ; again the Commission of Agricultural statistics, some of whose members

have been appointed specially for the agricultural census of the world, which has already met here to examine the plan of work for the census put before it by the Institute; and the Institute will continue to appoint other Commissions which may deal with the examination of certain questions from different angles, either separately or together. And as it is not always easy to assemble Commissions and it is desirable that the questions should be thoroughly prepared in advance, the Institute has also arranged to have the advice of experts by means of consultations.

As regards the working of the Commission, the Permanent Committee has selected a list of names, — a list which is not closed, for you yourselves can propose other colleagues who may also be added, — and the Commissions have been immediately assembled. At present it is the Permanent Committee of the Institute, composed of representatives of 71 States, which will examine your work, your technical scientific advice, and will decide what further proceedings should be taken. Then if your proposals are adopted, the Institute will take the matter up, its bureau will collect the technical or legislative material and will present properly drawn up questions to the General Assembly which meets every second year. As you see we have here an organisation which has existed for 18 years for all branches of agriculture, has collected enormous material, has suitable services, has a permanent diplomatic international organisation, is in constant relations with the Government of each country and is in a position to bring immediately into the field of realization whatever scientists can investigate and discover.

This is the first time that the Institute has set in motion these technical scientific Commissions, and I hope that the work which you have accomplished will be fruitful in good results for the work which the Institute has in hand.

PRESIDENT. — Thanked H. E. DE MICHELIS for his speech and for the explanation which he had given regarding the functions of the Commission. He then announced that the Sub-Commission had examined Nos. 2 and 4 of the programme of business namely the questions concerning (*a*) the plan of an international organisation for comparative tests of chemical fertilisers; (*b*) control of the chemical fertilisers trade.

With regard to the first question, the Sub-Commission recommended the following resolution :—

" The Commission expresses the wish that the work relating to researches on fertilisers should be continued by the International Institute of Agriculture by means of its agents of the Commission which it has appointed with that object and which might conveniently be enlarged, and that the works to be published on that question should be included in the International Review of Agricultural Information published by the Institute ".

As no one wished to speak, this resolution was adopted.

Regarding the question of control of the chemical fertiliser trade, the Sub-Commission recommends the following resolution :—

" The Commission considers it impossible, within a short time, to reach an international agreement for unifying the methods of fertiliser analysis. It thinks it possible to recommend for international transactions, unification of the method of expressing the results of analyses, namely :—

For nitrogenous fertilisers, expression in nitrogen, N, and not NH_3 per 100 kilogrammes indicating the form of the nitrogen.

For phosphatic fertilisers, expression in P_2O_5 and not in tricalcic phosphate, with indication of solubility in special reagents.

For potash, expression in K_2O, and solubility in a reagent of indicated composition.

The figures given must be accompanied by an indication of the method of analysis used ".

As no one wished to speak this resolution was adopted.

Regarding No. 5 of the programme :— *Miscellaneous questions.*

PRESIDENT. — Announced that the Sub-Commission had considered for the future the two following questions :—

(1) « The discussion of M. LEMMERMANN's proposal regarding control of chemical fertilisers and his proposal regarding the plan of experiment should be postponed to a later session.

With this object all official documents relating to methods of analysis and rules in force in different countries should be centralised at the International Institute of Agriculture ».

BRUNO. — Explained that the Sub-Commission had recommended the centralising of all official documents at the Institute, because it was not enough to have the methods of analysis and the laws and decrees relating to them, as there were also circulars and the modifications which resulted from legal decisions. In France, for example, there was a circular giving details of application. Now it was useful from an international point of view for men of one country to be kept in touch with the current requirements in other countries.

PRESIDENT. — Ascertained that no one opposed this proposal, and declared it approved.

(2) :—

" That the questions relating to various fertilisers or substances capable of affecting growth be also postponed ".

BRUNO. — Did not know whether this question could form part of the programme of the next meeting. In any case the Commission had not forgotten this matter, but considered it premature to deal with this question

on the spur of the moment, as time was required to collect papers and the proposals made on the subject and to sort out scientific proposals from those of pseudo-science.

PRESIDENT. — Ascertained that no one opposed this 2nd proposal, and declared it adopted.

A report would be made on all the resolutions adopted by the Commission, which would be presented for the approval of the Commission at the closing meeting, which would be held on Saturday 13th at 10 a. m.

The programme of business being then finished, he thanked once more the President of the Institute who had shown his great regard for science in creating this Commission of experts, which would do its best to assist the work of the Institute in the field of world agriculture.

PRESIDENT of the International Institute of Agriculture said that be would communicate the speech of the PRESIDENT of the Commission to the Permanent Committee of the Institute which would be glad to know that the Commission had worked so carefully and successfully.

The meeting ended at 11,15 a. m.

Closing meeting.

Saturday 13th February 1926.

Presidency of the PRESIDENT *of the International Institute of Agriculture.*

The meeting commenced at 10.15 a. m.

PRESIDENT. — Declared open the closing meeting of the 1st Conference of the International Commission for Chemical Fertilisers.

He announced that the Commission had presented a report in which was summed up its work and the conclusions to which it had come by the aid of its two Sub-Commissions. The report ended with the presentation of recommendations and wishes which would now be submitted for final approval. He called on M. JELINEK, President of the Commission to present the recommendations and wishes of the Commission.

JELINEK. — Said that M. CARDOSO would do so in his capacity of reporter.

PRESIDENT. — Asked M. CARDOSO to read out the resolutions question by question.

CARDOSO. — Then, in his capacity of reporter, presented the text of the agreement to be finally adopted by the Commision. He spoke as follows :—

" As regards the 1st question on the programme, 'Plan of international organisation for comparative tests of chemical fertilisers' the following resolution has been adopted :—

The Commission expresses the wish that the work relating to researches on fertilisers should be continued by the International Institute of Agriculture by means of the competent agents of the Com-

mission which it has appointed with that object and which might conveniently be enlarged.

That the work to be published on that question should be included in the International Review of Agricultural Information published by the Institute ".

PRESIDENT. — Declared that this resolution, which moreover agreed with the ideas which he had the honour of expressing on the opening day of the work of the Commission, conformed to the programme of business and to the ideas of the Institute and he could at once give an assurance that it would be approved by the Permanent Committee.

He ascertained that no one wished to speak ; he declared that recommendation unanimously adopted.

He asked M. CARDOSO to read out the recommendations regarding the second question " Standardisation of experiments on chemical fertilisers ".

Prof. CARDOSO. — Read out the following rules:—

INTERNATIONAL RULES FOR SCIENTIFIC EXPERIMENTS ON FERTILISERS.

(1) *Soil.* — Choose a soil as uniform as possible, and test it by a sufficient number of borings, arable layer down to ..... cm. subsoil ..... cm. Avoid ground with a steep slope, especially in not very permeable soil. If sloping ground has to be used mark out rectangular plots elongated at rightangles to the run of the valley.

(2) *Shape of the plots.* — Be guided by the possibilities of the ground and other local conditions for marking out square or rectangular plots.

(3) *Area of the plots.* — Give each plot a minimum area of 25 sq. m. and a maximum of 100 sq. m.

(4) *Number of plots.* — Repeat the same test at least 5 times and have at least 5 control plots.

(5) *Distribution of the plots.* — Distribute them uniformly according to the dimensions and lie of the ground.

(6) *Paths between the plots.* — The plots should be contiguous except for leaving a path in a single direction 50 cm. wide between every second plot to facilitate cultural operations and inspection. Seeding to cover uniformly the whole surface of the plot. For the harvest, plants to a width of 50 cm inside the boundaries of each plot are first of all removed. The experiments are therefore always separated from each other by a distance of 1 metre on 3 sides and by 1.m. 50 on the side of the path.

(6*a*). *Distribution of the fertilisers.* — The fertilisers should be applied accurately and regularly, special attention being given to the application of farm-yard manure. Each fertiliser should be applied at the most suitable time to have good effect, in one or several applications.

(7). *Duration of the tests.* — Continue the testing of the same areas during at least 5 years on successive crops.

(8) *Characteristics of the soil and climate.* — Note them and publish them with the results : — *Soil,* locality, depth, analysis (methods of the International Association of Soil Science, and for dry climates repeated determinations of the humidity of the soil). *Climate,* temperature, nebulosity, rainfall :— quality and number of days — snow — actinometry.

(8*a*). *Composition of the fertilisers.* — Always give precise indications of the fertilisers used :— nature, origin, fineness, complete chemical analysis and finally petrographic or micro-biological characters.

(9) *Plants used.* — Always use well-tested seeds, indicate their quality, the density of sowing. State very precisely the variety and origin.

(10) *Remarks on growth.* — Note the essential facts of growth, their dates, attacks of diseases or of parasites. Weeds. Treatment applied. Casualties or damage caused by meteorological factors or fortuitous.

(11) *Crop.* — It is recommended that the results should always be expressed in air-dried matter and in dry substance.

(11 *a*). *Experimental error.* — The experiment will be considered as demonstrative when the differences of the average results obtained are less than double the probable error.

(11 *b*). *Experimental Farms.* — The Commission considers it advisable to establish an experimental farm in each natural region subject to the direct control of Laboratories of the different departments cooperating in the improvement of agriculture.

PRESIDENT. — Ascertained that no one wished to speak. He therefore considered that all these rules were unanimously adopted by the Commission.

He asked the reporter to read out the resolution relating to the third question " Control of the chemical fertiliser trade ".

CARDOSO. — Read out the following resolution :—

The Commission considers it impossible, in a short time, to reach an international agreement for unifying the methods of fertiliser analysis.

It thinks it possible to recommend, for international transactions unification of the method of expressing results of analyses namely :—

for nitrogenous fertilisers, expression in nitrogen, N. and not NH_3 per 100 kilogrammes, indicating the form of the nitrogen ;

for phosphatic fertilisers, expression in P_2O_5 and not in tricalcic phosphate, with indication of solubility in special reagents ;

for potash, expression in K_2O and solubility in water or in a reagent of indicated composition.

The figures given must be accompanied by an indication of the method of analysis used.

PRESIDENT. — Declared this recommendation unanimously adopted. As regards proposals for the next meeting, he asked whether there were any other proposals besides that of M. LEMMERMANN, which had already been examined at the previous meetings.

BRUNO. — Thought that it would be useful at once to determine some subjects and he had already come to an arrangement with most of the interested parties regarding the reports which might be elaborated in view of the next meeting. He would therefore indicate the questions with the names of the proposed reporters.

REPORT FOR THE NEXT MEETING.

(1) Special implements for the execution of cultural experiments. Reporter, Prof. GRÉGOIRE.

(2) Dry climate and fertilisers. Reporter, Prof. QUINTANILLA.

(3) Choice of soil for experiment, borings, examination and reaction of the sample. Reporter, Prof. CHRISTENSEN.

(4) Presentation of the results of cultural experiments. — Standardization, notes, diagrams. Reporter, Prof. VON FEILITZEN.

(5) Practical application of experiments. Reporter, Prof. MENOZZI.

(6) Experiments on the relative efficiency and net return of manurings. Reporter, Prof. LEMMERMANN.

(7) Critical study of legislation and systems of control of the trade in chemical fertilisers in use in various countries. Reporter, Prof, JELINEK.

(8) Critical study of methods of analysis of fertilisers, in use in various countries. Reporter, M. BRUNO.

PRESIDENT.—No one wishing to speak, this programme is consequently adopted. We have in it a good piece of work which supplements the very interesting framework of the deliberations of the Commission ; the names

of the reporters are a sure guarantee of the seriousness of the reports and of their importance. At the last meeting of the Commission I had the pleasure of telling you that for the next conference of the Commission we hope to send invitations sufficiently early for the programme to be issued in good time and, as far as possible, to be correct. It will be subject to amendments and suggestions by the Commission. The reporters will be appointed in advance for the essential questions, as has already been done, and we hope by sending shortly the reports of this first conference to members who were unable to be present this session, among whom are some occupying a very eminent position in the field of chemical and agricultural science, to arouse in these gentlemen some ideas which have not yet been dealt with by the Commission and so to get further reports.

There are lastly, as you know, two proposals by M LEMMERMANN : one has already been included in the report considered ; the other relates to plans of experiments.

He proposes that

"all official documents relating to methods of analysis and to rules in force in various countries should be centralized at the International Institute of Agriculture".

No one wishing to speak, the proposal is therefore adopted.

M. JELINEK thanked the PRESIDENT of the Institute and assured him that the Commission would use all its knowledge and zeal in helping the Institute in its task.

M. QUINTANILLA made the following speech :—

Mr. PRESIDENT, Allow me on behalf of all my colleagues to offer our best thanks to you and to the Permanent Commitee of the Institute for the honour which has been paid us in inviting us to Rome for this important conference. We have known the International Institute of Agriculture for a long time, a magnificent work of human solidarity and progress, whose creation was due to the generous sentiments of H. M. the King of Italy, an institute which has already rendered considerable and universally appreciated services in all branches of agriculture from an international point of view. Its publications and manifest activities have bruited abroad to all the world the excellence of its organisation and the competence of its staff, a staff recruited from all countries in the world. Scientific circles of every country have heard with very great pleasure and interest of the recent creation of the International Scientific Council of the International Institute of Agriculture, of which our Commission is one of the organs.

As you have rightly said, Mr. PRESIDENT, the Institute ought, among other primary functions for the welfare of universal agriculture, to play the part of coordinator of scientific initiative and research in the agricultural world which would otherwise be disconnected and consequently deprived of a good deal of their efficiency.

The International Institute of Agriculture, which is an organisation of States and has the right of initiative with governments by the terms of

its foundation charter, is in a unique position, through the agency of its Permanent Committee and its General Assemblies to effect the incorporation in laws and measures of an official character of the recommendations and wishes which it requires from us experts on stated questions. Research is not enough unless it ends in practice. The International Scientific Council of the Institute is a typically elastic creation which can continually expand by the formation of new commissions, and thus render inestimable services even to governments and the entire human race, subject however to the condition that these Commissions are composed of the most qualified men of renown. My colleagues and I, who are specialists, know quite well that all branches of agricultural economy and science are bound up together, that the agricultural problem has administrative, political and social sides, which only a State Institution can consider as a whole. We therefore wish a long and prosperous existence to this Institute, under your vigorous and enlightened Presidency and under the management of a Permanent Committee on which all States in the world are represented. We all know, M. President, your indefatigable activity, the originality of your views and the very vigorous manner in which you defend the interests and the prerogatives of the great Institution of States, to the head of which you have been called by the unanimous confidence of your colleagues on the Permanent Committee. Thanking you and the Permanent Committee for having invited us others who are present here, we wish you M. President, the Permanent Committee and the whole Institute a prosperous and fruitful life for the welfare of agriculture all over the world. (*Applause*).

The PRESIDENT of the Institute replied as follows :—

I think that the speech which has just been made has suggested to the President the programme of work which remains for him to accom plish.

I am particularly happy to be able to be here at the end of this first experiment of the organisation which the Permanent Committee, on my suggestion, has adopted for constituting the scientific Council of the International Institute of Agriculture, because it should be noted, and everyone will note, that the work accomplished by this Commission has been — the expression is not out of place — truly important. During their meetings competent men assembled here have found themselves all agreed, after having examined the matter which was submitted to them, in presenting resolutions which mark a stage in the study of the question of chemical fertilisers by fixing the principal points for the establishment of the necessary methods for future experiment. This is a very interesting and important matter from an agricultural point of view because, perhaps in this field more than in other, it is necessary that the most economical methods of production should be pointed out to the producer, seeing that such demonstration has a happy result for the consumer.

The Commission has therefore fixed precise points for the experiments which will be begun in future, and this will throw considerable light on experiments which have been made up to the present time.

I therefore wish to thank all members of the Commission and in par-

ticular its President M. JELINEK, the three Vice-Presidents Messer. CHRISTENSEN, BRUNO and LEMMERMANN, who have given the Commission the support of their world renowned competence. I also thank the reporters who have drafted the resolutions voted.

I think therefore that the commencement of the work of our Scientific Council is auspicious and as M. QUINTANILLA has just said, this work will enable the Permanent Committee to expedite the appointment of other Commissions; and the results that will be obtained from the work of these Commissions may throw a deserved radiance on the Scientific Council. We have here a permanent observation post; the Institute is the permanent propagandist of all that is useful to agricultural production; henceforth we shall have here an organisation which will give greater authority to our efforts and to our work. I thank you again for having come to Rome and for having accepted our invitation, and I hope that on return to your countries you will remain attached to the Institute by the recollection of the agreeable work which you have done and for which we are grateful to you.

I also hope that you will take back with you from this country, if not the luminous vision which we generally have here because of the sun and the fine weather, at least the impression of its living activity and of its desire of peace and quietness, and that you will never forget that surrounded by the lawns of the Villa Borghese there is a palace where a group of workers is ready to collaborate for technique and science in the field of agriculture. (*Applause*).

I announce the termination of the 1st conference of the Commission for the Study of Chemical Fertilisers.

The meeting ended at 11.15 a. m.

VISIT TO THE HYDRO-ELECTRIC AND NITROGEN FIXING WORKS AT TERNI.

After this first conference, the "Terni", a hydro-electric company, was good enough through its Manager Delegate, Chief Engineer Bocciardo, to invite the experts and observers to visit the establishments situated at Terni and at a place near by. A number of persons taking part in the excursion went to Terni on Sunday 14th February, where the engineers and chemists belonging to the Company were placed at their disposal to accompany them through the workshops and to explain their working. In the morning the hydro-electric station situated near Papigno and then the kilns for the manufacture of carbide and the operations for the transformation of the latter into cyanamide, were visited.

After an excellent lunch given to the visitors, they were accompanied in motors to Borgo Nera Montoro where there is a very fine establishment for the manufacture of synthetic ammonia, and these magnificent works and the most up to date high tension machinery were greatly admired. The guests were shown over the works at Terni with the greatest courtesy and rare competence by Engineer Comm. ALDIGHIERI ably assisted by Engineers SINIBALDI and GEMMA.

BANQUET.

The International Institute of Agriculture invited all members of the Commission to a banquet which took place on the 11th February 1926 at 8.15 p. m. at the Excelsior Hotel.

At this banquet the PRESIDENT of the International Institute of Agriculture, M. JELINEK President of the Commission and Dr. BERTRAND on behalf of the audience who were present at the meetings of the Commission, made speeches.

They warmly thanked the Institute for the invitation it had given them, and Dr. BERTRAND especially gave an assurance that the whole support of the chemical fertiliser industry was at the disposal of the International Institute for the great work undertaken in the interests of worldwide agricultural progress. At this banquet were present :— H. E. Prof. PEGLION, Minister of National Economy ; the Delegates of the Permanent Committee and several eminent Italian agricultural authorities.

RATIFICATION BY THE VIII GENERAL ASSEMBLY OF 1926 OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE OF THE DECISIONS TAKEN BY THE FIRST CONFERENCE OF THE INTERNATIONAL COMMISSION ON CHEMICAL FERTILISERS.

" The General Assembly,

having seen the Report by M. H. DE SCAVENIUS, Delegate of Denmark, expresses its satisfaction with the measures taken with the object of carrying out the decision of the General Assembly of 1924 concerning questions relating to the supply of chemical fertilisers, recognizes the importance of the investigations indicated in the above-mentioned report and especially of the action taken for unifying research and experiment in the matter of fertilisers ;

recommends the Permanent Committee to see that the energy of the Institute in this field may be directed towards the practical realization, as soon as possible, of the programme arranged ".

APPENDIX I.

MEMORANDUM ON THE INTERNATIONAL ORGANISATION FOR THE STUDY OF CHEMICAL FERTILISERS.

Presented on the occasion of the visit of delegates of the Association of producers of Chili nitrate of soda to the International Institute of Agriculture by Dr. G. A. R. BORGHESANI, Head of the Agricultural Scientific Service of the International Institute of Agriculture.

Ambassador VILLEGAS' *proposals for international co-operation.*

His Excellency, Don E. VILLEGAS, Ambassador of Chile and Delegate to the International Institute of Agriculture, since the General Assembly of the Institute of 1920 drew attention to the importance of encouraging the use of chemical fertilisers in view of the intensification of agricultural production.

Later, on the occasion of the 6th General Assembly in May 1922, H. E. VILLEGAS in his Report on production and consumption of chemical fertilisers proposed co-operation for the benefit of the progress of agriculture and the fertiliser industry as follows :—

« It is evident that the Institute cannot propose practical measures regulating the trade in fertilisers without first studying the interests involved. The necessary basis for this is already given, namely the results obtained by the enquiry on fertilisers and the publication of a monograph on this question by the Institute.

« When presenting my resolution on the occasion of the last General Assembly I spoke about the meeting held in Rotterdam in 1919, which was attended by all the principal combines interested in the production of nitro genous fertilisers such as Nitrate of Soda, Sulphate of Ammonia and other synthetic nitrogenous fertilisers.

« During that meeting the question was brought forward of the study of certain problems of this production, and a common action was suggested similar to the one, in view of which agreements had been come to with and within the combines of other chemical fertilisers such as Phosphates and Potash Salts.

« As a matter of fact, in spite of the conditions being different on certain points, we are informed of a tendency of co-operative work between these combines.

« The first question to be considered for such action is that of taking the initiative and I think that the Institute, which is and must always be outside all party interests, should be approached for this function.

" This question could be brought up again a further stage, and it would serve the purpose if the Institute would have prepared for that occasion all the necessary papers, and having previously obtained the authorisation of the Governments concerned, could bring itself into touch with the organisations in question ".

Decision of the VI. General Assembly of the International Institute of Agriculture.

The General Assembly approved the motion of H. E. VILLEGAS and came to the following conclusion :—

" The General Assembly notes with satisfaction the work accomplished with regard to supplying information to the producers and consumers of chemical fertilisers regarding the most convenient steps to be taken with a view to developing the use of chemical fertilisers and

decides

that the Permanent Committee after having communicated with and having obtained authorisation of the Governments should study the possibility of

keeping itself in touch with the great fertiliser combines as well as the consuming circles of agriculture, in order to advise the most efficacious and appropriate means and measures for facilitating and regulating the economical provision of chemical fertilisers in the joint interest of the producers as well as of the agriculture of all the world ".

The reasons put forward by the Chilean Delegate are so obvious and convincing that there is no need to go any further into this matter.

The same point of view was also taken a few months ago at Paris on the occasion of a meeting of the " Comptoir Français de l'Azote ", which was attended by many representatives of the fertiliser industry of various countries.

The usefulness and even necessity of joint action being undisputable, there only remains the question of the organisation thereof and it seems that the International Institute of Agriculture offers the best ground for such organisation, as it has amongst its objects the promotion of the progress of agricultural industries and is at the same time extraneous to all party interests.

Need of an International Agricultural Research Organisation.

The Institute has already promoted similar movements in other branches of Agricultural Science, such as the International Society of Soil Science and the International Seed Testing Association etc., and it is the Agricultural Science Bureau of the International Institute of Agriculture which is the acting organ of this movement. This service, considering the process of agricultural production as such, can have a marked and decided influence on the increase of the production of agricultural staple products in all countries which need it, especially European ones, and can also render the production more profitable for countries, which have already an abundant production as for instance the United States.

In fact, if we consider the technical organisation of agriculture we find it much behind that of industry, trade and finance. From this arises the first cause of the inferiority of agriculture in comparision with industry, commerce and finance, which have taken advantage of the progress in modern science. This progress is essentially due to the universal character of science to which all the world gives its share, whilst for agricultural science every country, even every agronomist works on his own account, so that the experience gained by one does not serve anybody else, failing which the application of such experience on a large scale is impossible.

This deficiency of the agricultural industry, which is one of the reasons of its bad situation, is indeed felt especially in the more progressive countries, and remedies for this situation are being tried in different quarters.

The International Institute of Agriculture by means of its Agricultural Science Service has in part promoted this movement, of which it could be the coordinator.

In fact we see that around the Agricultural Science Bureau there have been formed the following associations :—

The International Society of Soil Science, which unites already all the experts of this science, so important to agriculture, from Japan to the United States, from Finland to South Africa, from Argentina to Polynesia ;

The International Seed Testng Association, which comprises more than 400 seed testing stations all over the World ;

The International Combine of Wheat Breeders ;

The International Association of Poultry Breeders ;

The International Federation of Dairymen ;

The International Commissions of Olive-growers ;

The International Commission for Eliminating the Damages caused by industrial Smoke, and many others.

Indeed, on the occasion of the last International Congress of Agriculture in Warsaw there was not one branch of agriculture in which the necessity of international coordination was not felt, and with this coordination the International Institute was entrusted.

As can be seen, the work proposed is immense and requires the co-operation of all the scientists and agronomists of the world.

An International Scientific Fertilisers Service.

It is evident that the Agricultural Science Bureau cannot be substituted for work in every branch of agricultural science, but as we have previously seen, can be a very useful co-operator and can help to obtain good results.

Its chief activity will always consist in collecting, classifying and distributing all useful information on agricultural questions. The difficulty of this work is to execute it thoroughly so as to have all information complete and clear cut, and the only way to attain this is to develop the work branch by branch with the help and co-operation of all quarters concerned.

This has been achieved in the cases of the International Society of Soil Science and the International Seed Testing Association. Thus the International Institute of Agriculture publishes the first complete review on soil science, and beginning with next month also the first international periodical on seed testing.

The same might be arranged for the fertiliser industry, namely the publication of a quarterly *Review* containing original articles by experts on all important and actual questions of this industry, and also complete abstracts of all publications concerning the production and consumption of fertilisers. A third part of this Review might contain a statement of the fertiliser market as compared with that of agricultural products, there being evidently a strict relation between the prices of these two lines of wares. This part will be an international development of the corresponding very interesting information given for Germany by the German review " Zeitschrift für Pflanzenernährung und -Düngung ". Such publication, as a part of the *International Review of the Science and Practice of Agriculture*, would be of the greatest interest for the producers, as well as for traders and consumers' organisations of fertilisers, to whom a special reprint might be sent as is similarly done for the members of the International Society of Soil Science.

Connected with this there might be also a service of *Information* on the basis of the Card system of the Institute, which at present has already collected more than 200,000 cards giving notice of all information on agriculture contained in the 3000 periodicals received by the Institute.

The Institute would also organise special *Studies* and *Research* work, such as is already effected by the publication of the Monograph on production and consumption of fertilisers, which has served as a basis for international fertiliser statistics, and which in the course of time naturally ought to and will be completed and improved.

On this occasion one may also mention the proposal of an *International plan for the organisation of comparative tests of fertilisers*, which will be brought forward at the next General Assembly of the International Institute of Agriculture. It is well known that agricultural field experiments have not yet given the results expected, and the principal reason for this is the lack of a common plan and of standardisation of experimental methods.

The best progress has been attained in the more highly developed agricultural countries such as Denmark, Finland, Germany, etc., and it has been found that experiments in order to give useful results must be executed on the largest scale possible, following the three fundamental principles :—

(1) Uniform management and work all over the world with regard to agricultural experiments ;

(2) Close participation and co-operation in the experimental work on the part of practical agriculture ;

(3) Co-ordination by a special control organisation.

Strict adherence to these three rules, even for individual countries only, is the secret of the success of milk recording in Denmark, which has quintupled the production of milk per head.

As previously said, in order that such intelligence service may be useful, there must be a close co-operation of all interested and we think that the help of the Delegates of the Chilean Nitrate Producers' Association might be very useful indeed for obtaining not only printed but also direct information through their direct and wide experience.

Summary.

In conclusion we think that the Agricultural Science Bureau of the International Institute of Agriculture with the co-operation and help of all the competent fertiliser organisations can develop a useful international action on the following lines :—

(1) Publication of a *Quarterly Review* containing all the information on fertiliser industry in the world ;

(2) An *Information Service* by means of the card system ;

(3) Preparation of special studies and researches ;

(4) Organisation of meetings and conferences for the treatment of urgent questions ;

(5) Co-operation of all the fertiliser organisations of the world in the shape of an International Consulting Board or Committee connected with the Agricultural Science Bureau of the International Institute of Agriculture.

There remains the question of means.

Evidently, the Institute can offer its organisation, but to develop the work efficiently, a certain contribution on the part of the interested parties would be required.

To quote a figure without engagement, we think that a sum of about 100,000 Lire a year for the beginning would be sufficient, increasing up to a maximum of 1,000,000 Lire.

At first, for the launching of the *International Fertilisers Review* and *Information Service* the first quoted sum would suffice; another question however is the development of research work on a large basis and the preparation of the special studies, which would require additional means.

Altogether, we think that the figures quoted for developing this preliminary programme, supported by all the fertiliser organisations, would not weigh upon them very heavily, but can even be considered as small in comparison with the results obtained. This amount would only be partly used for staff and similar expenses at the Institute, the main part would be expended for the organisation of co-operative work all over the world.

APPENDIX II.

COMMUNICATION PRESENTED AT THE CONFERENCE BY PROF. DR. LEMMERMANN.

It would certainly be very useful if a part at least of the thousands of researches on fertilisers were made in accordance with a single plan.

A better general view of many very important questions affecting the practical rules for the use of fertilisers would be obtained in this way. The interest of these researches would be still further increased if the results collected were studied and coordinated in accordance with a single plan in a single centre.

Such researches thus organised would evidently be of great utility for various agriculturists as well as for agriculture as a whole and for the social economy of each country.

All questions relating to plant nutrition are in the highest degree questions affecting the feeding of the people. On the basis of these considerations I have tried in Germany since 1924 to make researches on fertilisers throughout Germany in accordance with a single uniform plan of experiments.

Under this plan should be rigourously determined :—

(1) What soils in the various regions of Germany react to a manuring with N, P_2O_5 K_2O, lime, what soils do not react ?

(2) In what quantities should the fertilisers be applied ?

(3) What maxima crops can be obtained ?

By continuing in this way, we hope to establish an international plan of organisation for tests of fertilisers, and an agreement on the fertiliser problem would in my opinion be very desirable and should be placed in the programme of such an international plan of experiments, since the problems of fertilisers differ very much one from another and each requires a special method of research.

I think that out of the whole of the questions affecting manuring the following might be discussed by an international organisation :—

(I). *Investigation of the efficiency of different forms of nitrogenous, phosphatic, potassic fertilisers*: for example, effect of nitric Nitrogen, ammoniacal Nitrogen, Nitrogen of cyanamide of calcium, etc.; effect of acid phosphates, basic phosphates; effect of salts of potash, salts with high percentage, etc.

These questions are really important for agriculturists and for the manufacturers of fertilisers in all countries. (See IV).

(II). *Researches on the production of various fertilising elements, especially nitrogen.*

Nitrogen is the element which in most cases has most influence on yields.

On the average 1 kilo. of nitrogen gives the following extra yields:

	cereals	grains	potatoes	sugar beet	mangolds	hay
Kg.	19	20	100	133	266	40

or 100 K. of nitrogenous fertiliser give an excess of 2.5-4, 15-20, 20-25, 35-40, and 6 quintals respectively.

Even if the soil is left out of consideration these figures differ according to the climate. More accurate estimates can be made when the results of observations have been more accurately obtained.

(III). *To what extent can increased crops be obtained in various countries by means of the use of fertilisers, taking the net return into account.*

Estimates have shown that the highest possible crops in the temperate zone are per hectare :—

About 100-200 quintals of organic matter
40-48 » » cereals, grain + straw.
300-350 » » potatoes + haulms.

It seems that the limiting factors, light, heat, do not permit of higher yields. The importance of this question is evident.

(IV). Another question of general importance is this:

In what combination do fertilisers act best ?

Experiments make it appear that the nitrogen, potash, and phosphoric acid of the fertilisers have often a totally different action according as they are used in different combinations, each with its different chemical and physical characters.

I have found, for example, that the same quantities of fertilising elements gave the following crops according to their combinations :—

(pH of the field 5-6 according to manuring).

	Potatoes	Barley	Sugar beet
Neutral manuring (Urea and dicalcic phosphate).	207	33.2	355 q.
Acid manuring (Sulphate of ammonia and superphosphate)	228	33.8	314
Basic manuring (Saltpetre and Thomas slag)) .	152	30.4	392

(V). Another question which requires a plan of research is this: *How best to adapt the artificial fertilisers to the manurial state of the soils.* This question means the fixing of the soil's requirements of fertilisers.

The solution of this problem is the primary basis of all rational manuring and is particularly important, Laboratory researches in pots are a valuable help.

(VI). In these research plans the question of the *reaction of the soil*, the question of the state of soundness of the soil should not be neglected.

It must be decided whether this question should be discussed on the programme, since it is still far from being solved, and also it is to form the subject of international discussions in April 1926 in the Netherlands (Groningen) and in 1927 in America by competent specialists of the Association for soil research which is already in communication with the soil Bureau of the United States.

APPENDIX III.

REPORT BY DR. E. S. VOMULA DIRECTOR OF THE GOVERNMENT LABORATORY OF AGRICULTURAL CHEMISTRY IN FINLAND.

Presented by M. JÄNNES.

About the middle of the XIXth century Justus von LIEBIG having opened new channels by his experimental work and having demonstrated the great importance for agriculture of natural science especially chemistry, the first stations of experimental agriculture and control for agricultural produce were founded.

When later the first chemical fertilisers appeared on the market all civilized countries recognized the necessity of having special chemical laboratories for testing these products. Finland also shewed a keen interest in the chemical investigation of the principal agricultural questions during the years 1850-1860. Some fifteen more years however elapsed before the aspirations of agricultural chemists and agriculturists in Finland were realized so as to establish the required results on a solid basis. The foundation in 1880 of the chemical laboratory for agriculture and commerce at Helsinki (Helsingfors) may be considered as one of the practical results of these aspirations. This first laboratory of agricultural chemistry and control in Finland began to function at the beginning of the following year.

It only required a short time for the services rendered by the Helsinki laboratory to agriculture to be recognized in agricultural circles and for other similar though slightly smaller laboratories to be founded in other parts of the country. During the years 1880 to 1890 in all four other chemical laboratories for agriculture and commerce were established in the following towns :— Turku (Abó) Viipuri (Wiborg) Vaasa and Kuopio : at present only the first three still exist. As their denomination indicates, the Finnish control laboratories investigate not only fertilisers and cattle foods but also other kinds of goods. In the early years after the creation of these laboratories the number of samples of fertilisers and foods investigated only represented a fraction of the total number of analyses made. This was after all very natural, for Finland then had not yet any law regulating the fertiliser and cattle food trades, and persons practising agriculture only rarely asked for the testing of goods which they bought. Consequently it was not possible to prevent the circulation in trade of worthless and adulterated fertilisers and of injurious or damaged cattle foods.

In order to introduce better arrangement and greater security into the trade of these products a regulation of the trade in fertilisers and cattle foods was published in 1901. It is from the date of its publication that the official control of agricultural products effectively started in Finland, but this regulation was not sufficiently severe to put an end to commercial abuses ; it was defective in various ways. Thus, for example, the vendor was not obliged to give the purchaser a guarantee certificate regarding the content of the goods for such of its integral parts as constituted its value ; consequently the farmers only derived very little benefit from this regulation and agricultural circles have never been satisfied with it.

During the years of the war and especially during those which came immediately after them, agriculture expressed a desire for fresh legislative regulation of the fertiliser and cattle foods trade.

Recognizing the justice of this desire, the Finnish Government in 1921 charged a commission, under the presidency of Dr. JUHO JÄNNES, with the elaboration of a draft law on the fertiliser and cattle foods trade. The draft was finished in 1923 and submitted to the Reichstag in the course of the same year. Having been passed by the Reichstag the law come into force on the 15th June 1924.

This law marks great progress in the control of agricultural products in Finland. One of the most important provisions of this law is that the vendor is always obliged to give the purchaser a guarantee regarding the component parts of the goods which determine its value, when the quantity of goods sold in a single lot is not less than 100 kg. The regulation for the application of the law indicates the manner in which the integral parts which determine the value should be designated. We quote, for the sake of example, the following prescriptions :—

When selling Thomas slag, its content in phosphoric acid soluble in a 2 % solution of citric acid must be indicated. For bone meal the purchaser must be informed regarding the total quantity of phosphoric acid which it contains. The price of superphosphate is determined by the quantity of phosphoric acid soluble in water indicated in the guarantee certificate, and that of potassic salts by the quantity of potassium soluble in water. As regards fertilisers containing nitrates and ammoniacal salts, their content in nitrogen must be indicated. When selling oil-cakes, the vendor must guarantee their content in fats, crude protein and ash. The guarantee certificates for bran and other milling or distillation refuse as well as those delivered for mixed foods, should indicate the quantity of non-nitrogenous extracts. The regulation also orders that the guarantee certificates shall not contain other data than those indicated in the regulation.

If the purchaser of fertilisers or cattle foods desires a second analysis made of the goods which he has bought, to verify the indications on the guarantee certificate, he should have a sample taken by two trustworthy and unexceptionable persons within a period of 14 days after the consignment of the goods and send this sample for analysis to the Government laboratory of agricultural Chemistry. The sample must be taken, in conformity with the orders in force, drawing up a written statement in duplicate.

If the analysis made by the Government laboratory of agricultural chemis

try shows a smaller content than that which was guaranteed, the vendor is liable to pay compensation, in case the difference between the ascertained content and that which had been guaranteed exceeds the limits fixed officially for discrepancies of analysis (delivery allowance). For the sake of example, we quote the following discrepancies of analysis: — for phosphoric acid soluble in a 2 % solution of citric acid of Thomas slag a deficiency of 0.60 % is admissible; for the phosphoric acid contained in other phosphatic fertilisers the difference may be 0.50 %; for nitrogen of cyanamides 0.50 %; and for other nitrogenous fertilisers 0.25 %. The content in crude protein and in fats of oil-cakes and mixed foods may only be from 2 to 1 % less than that which was guaranteed. The guarantee certificate will indicate the price of the fertilisers proportionally to the price per kg. of the integral parts which determine its value.

Some of the more important prescriptions of the law in question may also be mentioned. In the first place any one producing or importing fertilisers, cattle foods or other products used on farms, is required to declare it in writing to the central bureau of agriculture giving at least one month's notive before the said goods are placed on the market or before starting to produce them; he must declare on that occasion what the goods are, which he wishes to import or produce.

Also the prescription is very important which authorizes the Ministry of Agriculture to prohibit the production, importation and trade of fertilisers, cattle foods ad other products required by the farmer, which may be injurious or inefficient. Equally important is the prescription in virtue of which names of fertilisers and cattle foods must not in any way mislead the public.

The administration of the law is confided to the central bureau for agriculture and the Government laboratory of agricultural chemistry. This laboratory was founded simultaneously with the coming into force of the law which has just been briefly reviewed. The Government Laboratory of agricultural chemistry at Helsinki is the principal control station for the whole of Finland. It originated in the first control laboratory of Finland mentioned above which also has become a Government institution. The old Laboratory was abolished in February 1924, to be immediately replaced by the Government laboratory of Agricultural chemistry, which began to function without delay. Immediately after this reorganisation of the principal control station, the laboratory was considerably enlarged and furnished with all modern apparatus and installations necessary for chemical analyses.

From the beginning the new laboratory was managed in such a way as to be able to make several thousands of analyses a year, for an increase in the number of samples sent in for analysis had to be expected with the regulation of the trade by the new law. This expectation has indeed been fully realized. In 1925 the number of samples analysed exceeded 3000, of which 811 were samples of fertilisers and 1464 samples of cattle foods.

The Government laboratory of agricultural chemistry has appointed sworn experts for taking samples at the maritime ports and other places important for the fertiliser and cattle food trade in various parts of the country. At present these sworn experts number 12, and they are authorized to take samples of fertilisers and foods, in conformity with rules made for this purpose, at the

request of importers, manufacturers or vendors. Each general sample taken is divided into three lots one of which is sent to the Government laboratory of agricultural chemistry.

The principal tenour of the present Finnish legislation regarding the chemical control of agricultural products has been described above. It will be seen that the Finnish law is rather too liberal than too severe. The legislation still leaves something to be desired on some points and consequently the management of the Government laboratory of agricultural chemistry, the President of which is Dr. J. VALMARI, Professor of agricultural chemistry at the University of Helsinki, has prepared a draft amendment aiming at the improvement of the present regulations.

As this draft has not yet been approved by the competent authorities and as the final form which it will take has not yet been determined, only certain fundamental principles of the provisions which it contains can be mentioned.

The draft begins by defining the legal designation of fertilisers and as cattle foods. It determines in detail the requirements which fertilisers and foods placed in the market must satisfy as regards quality. Then, it is proposed to make the taking of samples obligatory for parcels of fertilisers or cattle foods imported or produced, when they exceeds 1000 kg. According to the amendment firms which trade in fertilisers or cattlefoods must adopt a system of book-keeping in conformity with instructions of the Bureau of agriculture. In most cases the amendment differs but little from the present regulation, which is due to the fact that the fundamental law is maintained without change.

May I be permitted on this occasion to declare that it would be very desirable for the International Institute of Agriculture at Rome to investigate the urgent question of methods of analysis from an international point of view. As far as is known, there is not at present any method of analysis universally recognised that may be applied for international relations. In fact, the regulations for methods of analysis of fertilisers and foodstuffs applied for international relations which were established by the Vth International Congress of applied chemistry in 1903 at Berlin, are already out of date. It is to be hoped that it will be possible to attain also greater uniformity of principles in accordance with which the value of fertilisers and cattlefoods is determined. This wish relates especially to the determination of prices of phosphatic fertilisers.

APPENDIX IV.

THE SCANDINAVIAN SOCIETY OF AGRONOMY

by Professor C. A. H. VON FEILITZEN, Stockholm, Sweden.

The Scandinavian Society of Agronomy was founded in 1918 at Stockholm. Its object is to bring together all agricultural experts and those interested in agricultural research, and to encourage agricultural research in the four Scandinavian Countries :— Sweden, Norway, Denmark and Finland.

The Society has now 1230 members of whom 422 represent Sweden, 253 Norway, 288 Denmark, and 267 Finland.

The Society publishes a monthly bulletin called Nordisk Jordbruks-forskning, it includes eleven sections, namely :—

(1) for researches on garden plants
(2) » seeds and seed tests
(3) » genetics
(4) » plant pathology
(5) » agro-geology
(6) » agricultural economy
(7) » cattle breeding
(8) » experiments on fertilisers and improvements
(9) » tillage and drainage
(10) » forage crops and pastures
(11) » experimental technique and mathematics applied to calculations of experiments.

Up to the present the Sociey has held 2 congresses, one in 1921 at Copenhagen and the second in 1923 at Gottenburg, and this year the 3rd Congress is going to be held in Norway at Oslo.

Section 8 for experiments on fertilisers should be very interesting to the international Commission. The section has 78 members. Since the section was founded I have had the honour to be the President. A Commission for the standardisation of experiments on fertilisers was elected in 1920, on my proposal, with one member for each country (2 for Denmark). I was elected President of this Commission, and out of its members are present here from Denmark Dr. HARALD CHRISTENSEN and from Norway Professor LENDE-NJAA. The two others are organisers of agricultural societies, M. K. KRISTENSEN in Jutland, Denmark, and Prof. A. RINDELL at Abo, Norway.

The Commission has worked out standard plans for fertiliser experiments which wese accepted at the Copenhagen Congress (1921) and published in the report of the Congress. In November last the Commission also elaborated plans for conducting experiments on fertilisers and liming. This standardised plan is now adopted in Sweden, Denmark, Norway and Finland, and we have found it a great help for agricultural research. I only wish to tell you that last year about 1400 fertiliser experiments were made in Sweden, and over 2000 similar experiments in Denmark. The aim of standardisation is to give the greatest possibility of confidence in results. The work in the field is done by the organisers and their assistants who measure the plots, examine the soil, the fertilisers and everything. All the notes collected relating to the site and soil and the weights of the crops are made by them.

These tests are made on a large scale and repeated at least 4 or 5 times. We have plans for the different crops and the various types of soils, as well as for various fertilisers. The method used is published with details in the Congress Report of the Society at Copenhagen, 1921: it will be found on page 454.

I can also tell you that section 11 of our Society, which is the section for technical experiment and applied mathematics, has elected a committee to prepare a mutual plan for making experiments on manuring and varieties, in the first place with oats.

The President of this committee is Professor BONDORFF of the Agricultural College of Copenhagen.

We have quite recently arranged the details and we want to start this year with experiments on nitrates in different doses in 15 centres in Sweden and as many centres in Denmark, Norway and Finland.

This is very interesting work and we have found already by earlier experiments that the different varieties of oats have actually different capacities for absorbing and utilising the fertilisers which are given to them.

If you are interested in details of the work of the standardisation committee of the Scandinavian Society, I will give you them with pleasure in a communication to the International Review of Agriculture of the International Institute of Agriculture in German.

The name of the Society is in French " L'Association des agronomes scientifiques scandinaves ", and in German " Verein zur Förderung landw. Forschung in den Nordischen Ländern ".

The official name of the Society is " Nordiske Jordbruksforskares Forening" and its office is in Copenhagen, where its General Secretary Mr. LUNDING lives.

GENERAL NOTICES.

N. B. — Starting with the next number the proceedings of the International Commission for the Study of Chemical Fertilisers will appear in three sections on the analogy of those of the International Society of Soil Science, of the International Seed Testing Association, of the International Association of Poultry Breeders etc.

The first will consist of original articles and general information by acknowledged experts dealing with actual questions on fertilisers.

The second will consist of notices and bibliography based on the originals dealing with important publications in every part of the world on fertilisers and their use.

The third will deal with matters of general interest and will give information on the state of the markets and on the most important events in the sphere of International fertilisers.

CURRENT NOTICES

Legislative and Administrative Measures.

430. **The International Agreement for the establishment in Paris of an International Bureau of Epizootics, approved 25 January 1924.**— By a law passed in March last, the President of the French Republic has been authorized to ratify and in case of need to give effect to the above agreement, signed 25 January 1924, by the following nations : Argentina, Belgium, Brazil, Bulgaria, Denmark, Egypt, Spain, Finland France, Great Britain, Greece, Guatemala, Hungary, Italy, Luxemburg, Morocco, Mexico, Principality of Monaco, Holland, Peru, Poland, Portugal, Rumania, Siam, Sweden, Switzerland, Czechoslovakia, Regency of Tunis

431. **Brazil: Regulation of the Forestry Service.**— The decree on this subject, referring to the law of 28 December 1921, takes into account in the order given the purposes of: the forestry service, the administration of this service, inaccessible forests, forest nurseries, the model forest, forestry control, forest statistics, forest reserves, national parks and forest police. For each of these subjects there is a corresponding heading in the decree, and in this way there is a ruling for every detail connected with the forest resources of Brazil. (International Institute of Agriculture. Legislative Texts, 1925).

432. **Spain : A Legislative Forestry Index.** — Ing. ENRIQUE DE LAS CUEVAS has published this 'Legislative Forestry Index' which contains all the official provisions and the judicial pronouncements made on forestry question. as also on special questions connected with these : river fisheries, water, mining, electrical installations, forced expropriations, etc., all entered in order of date in the chronological index. There is also an alphabetical index making possible a quick reference to any part of the subject Enquiries to the Imprenta de la Viuda de M. Aguaron, Huexa. Price ten pesetas, 553 pages quarto.

433. **France : Repression of Fraud in the Fertiliser Trade.** — Regulations have been issued for the application of the laws of 4 February 1888 and of 19 March 1925 relating to these frauds. The special features of this new legislation on the subject are as follows : (*a*) reinforcement of the measures already contained in the law of 1888, relating to the obligation for the seller to furnish the purchaser with all the information of value on the nature and on the place of origin of the fertiliser, the percentage and the origin of the active elements which it contains and the way in which these elements are combined ; (*b*) suppression of the sale of the fertilisers, with fixation of the price in relation to the results of analysis ; (*c*) express confirmation of the

right of intervention of the municipal authorities for enquiry into and ascertainment of frauds. (*Journal Officiel*, 7-8 June 1926).

434. **France : Morocco : Encouragement of Agriculture.** — A decree of 20 March 1926 has fixed for the current year the rules under which a bonus of 50 francs is to be given for every hectare of land cleared and ploughed, as a preliminary measure, to the depth of at least 15 cm. The minimum area to be cleared and broken up has been fixed at 5 hectares. The total value of the bonus awarded to one and the same farmer in the course of the year may not exceed 10,000 francs.

Another Vizirial decree of the same date, 20 March 1926, regulates the awarding of a bonus, not to exceed 4000 francs, to persons who can bring evidence to show that they have bought in 1926 one or more new agricultural tractors with apparatus for the mechanical cultivation of quite new land, ploughs to be excluded. The bonus is at the rate of one tenth of the customs value of the imported machinery. (*Bulletin Officiel*, No. 701, 1926).

435. **Morocco : Uniform Regulation of Sales and Deliveries of Cereals.** — An enactment for this purpose has been prepared and issued by the Association of Moroccan Dealers and Exporters at Casablanca. It includes 57 articles, grouped under three main headings relating respectively to : the selling unit of the cereal (metric quintal) and the weight of the bags ; the deliveries, ascertainment of the weight of the respective deliveries in bags of a uniform capacity : the ascertainment of the quality of the goods and of the chaff, the guarantee of the specific weight. (*Feuille de Renseignements de la Direction générale de l'Agriculture, du Commerce et de la Colonisation du Maroc*, No. 7. Rabau, 1926).

436. **Morocco : Regulation of Game Reserves.** — Fixed by the decree of 18 February 1926 of the General Director of Agriculture, Trade and Colonisation. (*Feuille de Renseignements de la Direction générale de l'Agriculture, du Commerce et de la Colonisation*, No. 7. Rabat, 1926).

437. **Great Britain : Protection of Trade in Agricultural Products.** — The Ministry of Agriculture has given notice that arrangements have been made for the inspection, on application, of apiaries where bees are raised for sale. Where no brood diseases are found to be present in an apiary, an official certificate to that effect is given. For the present, it will not be possible to include Acarine disease in the scheme, and the certificates will relate solely to freedom from brood diseases, though they will not be issued for apiaries where Acarine disease is seen to be present The frames containing the combs of the colonies that are passed on inspection will be stamped to that effect, thus affording protection to the purchaser. (*The Journal of the Ministry oy Africulture*, Vol. XXXII, No. 12. London, 1926).

438. **Greece : Repression of Frauds in Flour.** — A decree law of last January has fixed the conditions to which flours imported from abroad into Greek territory must conform, with a view to maintaining their purity and their capacity for making wholesome bread. These provisions are substituted for those of the regulation of 25 March 1925, on imported flours. (*Annales des Falsifications et des Fraudes*, No. 207. Paris, 1926).

439. **Guatemala : Forestry Legislation.** — Legislation has been applied to questions of sylviculture in this country also. All wooded areas belonging

to the State or to the communes, and also to corporations and to private persons, have been placed under government control. The various forestry areas have been divided for administrative reasons into : *a*) the bala region supplying the " *chicle* " and including the departments of Paten and the southern district ; *b*) the mahogany region, which includes the territories stretching from the sea level to 1500 feet ; *c*) the cotton region, up to an altitude of 2000 feet ; *d*) the coffee region, up to 5000 feet ; *e*) the pine region above 5000 feet. Each region is then divided into sections according to the forest species and the hydrographic system.

The law deals under separate heads with : the forest property of the State ; forest concessions ; felling of trees ; extraction of gums, resins, tanning materials. dyes, forest industries ; the Arbor day planting ; forest police and forest fires, (*El Guatemallteco*), No. 86, 1925).

440. **Italy : Extension of Fruit-growing and Horticulture in the Ager Romanus.** — By a decree of the Minister of National Economy bonuses are given to land owners, lease holders, tenants, etc., who, in the three years 1926-1927, 1927-1928, 1928-1929, have planted not less than one hectare of orchard specialised for industrial purposes or of vineyards for table grapes or of olive yards The bonuses are fixed at the rate of 25 % of the expenditure actually incurred and in any case not more than Lire 6000 per hectare. Field crops of vegetables are allowed in association with the orchard, vineyard or olive yard, provided the necessary precautions are taken against damage to the plantations.

Premiums of 200 to 800 liras per hectare have also been arranged for planting of watered or dry farmed market gardens in the administrative area of the Commune of Rome.

441. **Italy : Assistance to the Anti-Malaria-Campaign.** — The Government has arranged to admit duty free the residues of the distillation of mineral oils, when intended for the destruction of the larvae of the malarial mosquito. (*Gazzetta Ufficiale*, No. 93, 1926).

442. **Portugal : Legislative Measures for the Prevention of Development and Diffusion of Plant Diseases.** — In virtue of these the Government agricultural and forestry centres, agricultural schools, agricultural stations, forestry departments, etc., carry out measures of prophylaxis within a given area, and, after making careful examinations and taking samples, they report, from time to time, to the Laboratory of Plant Pathology of Verissimo di Almeida or to the Laboratory of Forest Biology. These two establishments are empowered to issue provisions for the preventive and curative treatment of the disease as ascertained, and to carry out suitable experiments, as may be necessary. either, on infected or infested estates or on an area at Tapada de Ajuda placed at the disposal of the Laboratory of Plant Pathology. The cost of carrying out the measures officially ordered in the different cases must be met by the respective landowners. (*Diário do Govêrno*, First Series, No. 224, 1925).

443. **Portugal : Agricultural Exchanges.** — All the Portuguese Government Services, established for the purpose of regulating trade in agricultural products and by products, have been centralised into a single department of ' Agricultural Exchanges '. It consists of a Secretariat, a Division

of Commercial Services and a Division of Public Consumption. The Secretariat is in its turn divided into two parts: (*a*) administrative, (*b*) arbitration or appeal section. This the Commercial Division contains two sub-sections: (1) information and propaganda, (2) commercial; which last the division of Public Consumption again has two parts: (*a*) provisioning, (*b*) inspection of agricultural products.

The Department of Agricultural Exchanges is establishing: 1. warehouses for storage and for movement of goods, equipped for the purpose with loading, unloading and weighing apparatus; 2. a depot for reception and classification of samples; 3. collections of samples of foodstuffs for the information of persons interested; 4. retail depots; 5. other subsidiary installations considered necessary. (*Diário do Govêrno*, First Series, No. 117, 1925).

444. **Switzerland: Measures relating to Wine.** — By a new ordinance of February last on the trade in foodstuffs, an explicit definition is given of the meaning of wine, and it is forbidden to employ in the wine trade fancy denominations likely to mislead the public as to the origin of the product. Indications in regard to origin (town or village, region, farm or vineyard), method of wine making, year, degree of alcohol, must be in accordance with the true state of affairs and exclude any possibility of confusion or error. It is forbidden to make use on the invoices, on stakes or labels, of any generic terms, such as 'type', 'brand' or 'kind', in reference to an indication of origin. The proportion of sulphates and of sulphurous anhydride which should be contained in the wines placed on the market is fixed by this Order. The new order replaces that of 8 May 1924.

Experiment Stations and Agricultural Instruction.

445. **Germany: Farm Experiment Clubs among the farmers of small or medium sized holdings in Wurtemberg.** — These clubs date from 1925 and were started at Herrenberg, Biberach and Heilbronn.

In order to have expert direction of these clubs provision was made for six of the most proficient of the ex-students of the winter schools of agriculture to pass into the Provincial Experiment Sowings at Hohenheim, so as to take a year's apprenticeship in experimental work. Future provision will be made in the same way, six former pupils of the schools mentioned to be taken each time. The Experiment Clubs thus formed are under the Local School of Agriculure and through that come under the Provincial Chamber of Agriculture which, makes financial provision for them. As well as the head farmer of the club, certain owners of agricultural land in the respective districts act as presidents. The expenses for each club annually amount to 2500 marks.

The object of the promotors of this scheme, which was to increase the number of field experiments seems to have been satisfactorily realized. (WEISS. Entstehung, Organisation und Entwicklung des bauerlichen Versuchsringwesens in Württemberg). (*Mitt. der Deutschen Landwirtschafts-Gesellschaft*, No. 14, 1926).

446. **Germany: Occasional Publications of the 'Biologische Reichsanstalt'.** — The State Institute of Biology (Biologische Reichsanstalt) has placed on sale its publications from time to time on the control of plant di-

seases and pests, They are collected into two sets : (*a*) control measures for field crops and forests ; (*b*) treatment of market gardens and vineyards. Each set contains 40 pamphlets, with index : price 2 RM. To be obtained from the Biologische Reichsanstalt, (Postsheckkonto Berlin, No. 75 or from the *Landesanstalt für Pflanzenbau und Pflanzenschutz*, Munich, Bavaria, Liebigstrasse, 25 (*Praktische Blätter für Pflanzenbau und Pflanzenschutz*, Year IV, No. 3. Freising, 1926).

447. **Germany : Academy of Domestic Science.** — Under the name of *Central für Hauswirtschaftswissenschaft*, a new section of the Berlin *Akademie für soziale und pedägogische Frauernarbeit* has been formed. This is the first attempt in Germany to raise to academic status the subject of domestic science.

The headquarters of the new Section is at the School of Agriculture (Berlin, No. 4, Invalidenstrasse 42).

448. **United States : A National Arboretum of the Department of Agriculture.** — The American Senate has approved the proposal providing for the purchase of the Mount Hamilton area near the Anacostia River, where it is intended to make a Federal Arboretum, and the sum of 300,000 dollars has been assigned for the purpose. (*Science*, Vol. LXIII, No. 1638).

449. **Canada : Faculty of Forestry of Toronto University.** — This faculty is now fully established. A special building, set apart for it, contains all that is essential for instruction and for forestry research : museums, library, laboratories, etc. The inaugural ceremonies took place on 19 to 21 January, and during the three days there were also held the annual meetings of the Canadian Society of Forest Engineers, the Canadian Forestry Association and the annual conference of the Ontario Foresters. (*Journal of Forestry*, Vol. 118, No. 3. Washington, 1926).

450. **United States : The Brooklyn Botanic Garden. N. Y.** — This institution is one of the leading scientific and educational institutions of New York. The Annual Report of the work of 1925 gives the figures of visiting classes from the public and private schools as over 58,000, while the attendance at the Botanic Garden classes was 30,000. Plant material has been supplied to over 2,200 teachers in the city schools, in quantity sufficient for the instruction of over 162,000 pupils. The Brooklyn Garden is in correspondence with 110 foreign gardens and a very considerable exchange of seeds has taken place. The plants raised from these seeds are annually enriching the plantations and have made the collection at the Brooklyn Garden one of the finest in respect of the number of varieties in the United States.

Special attention is called in the report to the effective work which the Botanic Garden is doing for wild flower conservation, in co-operation with other organizations : to the investigations in plant breeding, plant diseases and the vegetation of Long Island. The Director also calls attention to the disastrous effect on the trees of the garden and of all the city parks by the soot and fumes produced by the burning of oil and soft coal.

The Garden is also rendering an increasingly large service to industrial and commercial concerns through its bureau of information.

The Library receives over 800 periodicals from all parts of the world. (*Science*, Vol. LXIII, No. 1638. New York, 1926).

451. **United States: Missouri Botanical Garden.** — From the 37th report lately issued by the Director of this Garden and referring to 1925, it appears that a new site for an extension has just been acquired of about 1300 acres near Gray's Summit, 38 miles from St. Louis. It will thus be possible to grow plants which could not thrive in the city, and more particularly the magnificent collection of orchids will benefit from the change.

The report gives some account of the general activity of the Garden, both as regards the courses of instruction given and the experimental work. The investigations relate to plant breeding, and plant diseases, as well as physiology, cytology, chemistry and bacteriology. Special enquiries have been made into the subterranean algal flora, the smoke content of the atmosphere of St. Louis, etc. The report also emphasizes the steady growth of the herbarium, and of the library both of which sections are in constant use, alike by the staff and students and also by visitors from all parts. (*Missouri Botanical Garden Bulletin*, Vol. XLV, No. 1, St. Louis. No. 1926).

452. **United States: The Commercial Museum Philadelphia.** — This institution is devoted to the general extension of international commerce and the dissemination of information regarding the commercial products of the world. It is maintained by the City of Philadelphia, the State of Pennsylvania and by private subscriptions from business firms in the United States. It is a centre of such information and is in close touch with business houses all over the world, and an aid in opening up new markets for all useful natural or manufactured products. Its organization dates back to 1894 and it is managed by a Board of Trustees. The collection is rich in every kind of product from all regions of the world and is of high educational value. In 1924 it was visited by 34,907 pupils of the Pennsylvanian schools, and sixty-six illustrated lectures were delivered in these schools. The Museum material is also used for educational exhibits and a rich library amounting in 1924 to 48,353 volumes and 89,000 leaflets is available for readers. A special section of the institution known as the Foreign Trade Bureau is engaged as the name indicates in international commercial relations.

In 1924 the financial statement of the year showed that operations covered a sum of over 200,000 dollars. (*Report of the Philadelphia Museums. The Commercial Museum*. Series 1, 1924. Received at the International Institute of Agriculture in the current year).

453. **United States: Department of Tropical Research of the New York Zoological Society.** — This Society had nine years ago instituted a Tropical Research Department, which carried on from the beginning many and valuable enquiries in particular on the biological side. It has been especially active in 1925 and in *Science* (Vol. LXIII, No. 1638. Washington I, 1926) Prof. WILLIAM BEEB of the New York Zoological Park gives a full account of the work of this Department.

454. **Haiti: Demonstration Farms.** — The agricultural agents at Cayes, St. Marc and Gonaives recently held a conference in Port-au-Prince with the chief agricultural expert to work out plans for the improvement of the several demonstration farms under their supervision. Several contracts for demonstration farms in the Jacmel district have been arranged, in the Jérémie district at Marfranc a farm school has been located, and in that district too

active work has been done in teaching farmers to harvest their coffee with less damage to the plants than hitherto. (*Bulletin of the Pan-American Union*, January 1926).

455. **Trinidad : Imperial College of Tropical Agriculture.** — Dr MARTIN LAKE, director of this College, has published a report on the work during the session 1924-25, the third academic year of its life. The report bears witness to a remarkably vigorous development. In the course of the year, the first students completing their three year degree course have graduated with success. In addition to the teaching work undertaken by the staff, research and investigation has gone on into the cultivation of bananas, the sugar cane, cotton, tobacco and other plants. Studies in soil science, bio-chemistry and plant diseases have also been made. (*Tropical Agriculture*, Vol. III, No. 4. Trinidad, 1926).

456. **Hawaii : Agricultural Experiment Station.** — This Federal station which has headquarters in Honolulu has divided its work into different sections, agriculture, horticulture, chemistry and propaganda. It distributes improved and selected varieties of plants, and from the date of its foundation (1901) it has conducted numerous enquiries into the most varied agricultural problems. The results of these researches have been and are being collected in the Bulletins of the Station numbering about 200 issues. The Station is under the control of the Office of Experiment Stations of the U. S. Department of Agriculture. At the present time the director is Prof. J. M. WESTGATE. (*Journal of the Pan-Pacific Research Institution*, Vol. I, No. 1. Honolulu, 1926).

457. **Hawaii : Sugar Planters' Experiment Station.** — This is a private institution which from a modest beginning, in 1895, has had a vigorous development and is now organized in six sections : 1. *Entomological Section* which exercises control of insects injurious to the sugar cane, mainly by the introduction into the plantation of other insects which prey on the pests ; 2. *Pathological Section*, which studies the diseases to which the sugar cane is liable and co-operates with the other branches in the control of these diseasess ; 3. *Agricultural Section*, the object of which is the diffusion of new varieties of and the study of methods of cultivation ; 4. *Forestry Section*, which collaborates with the Government forestry officials on questions of irrigation ; 5. *Technological Section*, which collaborates with the chemical section in the supervision of the plants which elaborate and transform the sugar cane ; 6. *Chemical Section*, which conducts investigation of land which is to be devoted to sugar cane plantations. (*Journal of the Pan-Pacific Research Institution*, Vol. I, No. 3. Honolulu, 1926).

458. **France : Temporary School of Sericulture at the Montpellier National School of Agriculture.** — This was formed last spring, particularly with the idea of offering facilities for improvement in theory and technique to owners of sericultural establishments, directors of seed nurseries, and any other persons who devote themselves to the study of the silk worm. The courses naturally include lectures, practical work in the laboratory and the silkworm rooms, and excursions to the silk producing districts and to different establishments for the rearing of the worm and the production of seed. (*Bulletin de l'Office de Renseignements agricoles*, No. 7, 1926).

459. **France : Agricultural Problems treated by French Agricultural Engineers.** — The "*Association Amicale des Anciens Elèves de l'Institut National Agronomique*", also known as the "*Association des Ingénieurs Agronomes*", which has been in existence for about 60 years and has a membership of about 2000, has initiated a series of enquiries in the various fields of agricultural studies. The work is being divided between groups of members, according to special competence in the different subjects.

The President of the Association, EMILE SAILLARD, has selected for the purpose about 15 collaborators, and a brief report has been compiled by each of these on the progress made in the branch which formed the subject of their respective enquiries. The reports have since been published in one volume, divided into four sections : I. Rural Economy ; II. Agriculture ; III. Rural Engineering, Forestry, Horse-Breeding ; IV. Agricultural Industries.

There are in all sixteen reports, concise but clear, some of which deal with questions deeply engaging the attention of agricultural technicians, such as the electrification of the country districts, mechanical traction of special sorts, seed testing and the employment of selected seeds, the manufacture of synthetic nitrogenous fertilisers, etc. ; all reports bearing well known names in the field of agricultural science : PREAUD, JAGERSCHMIDT, DE SEYNES, BUSSARD, HITIER, etc. (*Les problèmes agricoles traités par des Ingénieurs agronomes*, No. 1, pp. 128, in small octavo ; Paris, 1926).

460. **France : Course of instruction in Cider-making at the Caen Pomological Station.** — This was a ten days course taking place in June last and the objects were : (*a*) to impart theoretical and practical knowledge relating to the making and conservation of cider ; (*b*) to make known the most essential methods of combining the ingredients by careful testing of the raw materials and of the manufactured products (proportions of the sugars, of the various acids, microscopic examinations, etc.). (*Bulletin de l'Office de Renseignements agricoles*, No. 8. Paris, 1926).

461. **France : Besse Biological Station, Puy-de-Dôme.** — This station is affiliated to the Faculty of Science of the Clermont University, and lies at an altitude of 1050 metres in the volcanic region of Monte Dore, close to the district of the Lakes of the Auvergne at the foot of the massif of Sancy in an area of forests and pasture land. It is thus especially well placed for studies of the classification, the distribution, and the biology of the plant and animal life of the lakes, the peat bogs and the mountains, as also for scientific work applied to zootechnical or sylvicultural questions.

The Station was opened to students this year and is to remain open from 15 June to 1 October. A certain number of rooms are available, with some accomodation for married persons, and meals can also be obtained at moderate prices. For information apply to the Director of the Station or to his assistant M. DENIS, botanical demonstrator, in the Science Faculty at Clermont (*Revue Générale de Botanique*, Vol. XXXVIII, No. 447. Paris, 1926).

462. **Great Britain : Official Seed Testing Station for England and Wales.** — According to the Eighth Annual Report on the work of the Station during the period August 1924-July 1925, the number of samples received for testing was 21.894, showing an increase of 3008 as compared with the preceding period. There was an increase of 100 per cent. in the number

of farmers sending samples for testing and an increase of 29 per cent. in the number of seed firms making use of the Station for the same purpose. An analysis of the samples shows that they include 9,066 samples of cereals, 1,891 of pulses, 4,148 of roots and vegetables, 4,283 of clovers, 2,334 of grasses, and 172 of miscellaneous seeds, including tree-seeds and linseed. The increase in the number of samples over the previous season is 30 per cent. in the case of clovers, 18 per cent. in the case of grasses, 16 per cent. in the case of cereals, and 13 per cent, in that of pulses.

The report appears in No. 5 of the " Journal of the National Institute of Agricultural Botany " copies of which may be obtained from the Institute at Huntingdon Road, Cambridge, price 1s, or 1s, 2d post free. (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 2. London, 1926).

463. **Great Britain : Research Laboratory for Fruit and Vegetable Preservation, London.** — The Secretary of the British Department of Scientific and Industrial Research announces that the Department has recently organized a small research Laboratory at Dudley House, Endell Street, in the vicinity of Covent Garden fruit and vegetable market. The laboratory will work in close connection with the Low Temperature Research Station, Cambridge, which is the head quarters of the fruit and vegetables section of the Department's organisation for food investigation. The object of the laboratory at Covent Garden is to bring the Station into closer contact with the trade in fruit and vegetables, and with the practical aspects of the problems of their transport and storage. (*Science*, Vol. LXIII, No. 1633, 1926).

464. **Great Britain : Young Farmers' Clubs.** — Interest in the Young Farmers' Club Movement is growing rapidly. Already forty-one counties have taken up the scheme and clubs to the number of forty-five have been successfully formed in twenty counties, with a membership to date of 1312. Negotiations are in progress in 124 centres to start new clubs. The County of East Sussex has published the first number of the " Boys' and Girls' Poultry Club Journal " for its 370 members. In Scotland, Young Farmers' Clubs have been formed in Caithness, Orkney, Sutherland and Ross and Cromarty with a membership of 85 members. All these clubs deal in a practical, interesting, commercial and up to date way with the following subjects : Beef and dairy calves, pigs, poultry, bees, rabbits (wool, fur and flesh), field crops, experiments with artificial manures, horticulture, intensive market gardening, simple cost accounting and management, public speaking and debating.

These clubs are proving to be assets of great value in both urban and rural life. (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 1. London, 1926).

465 **Great Britain : Publication of the Results of the Work of ths Agricultural Research Institutes.** — With further reference to thie subject to which attention was drawn in the last number of this Review (*Current Notices*, No. 254), it may be added that the fourth of the monographs published by the Ministry of Agriculture has appeared, entitled " Wheat Breeding Investigations at the Plant Breeding Institute, Cambridge ". The publication (114 pages and 30 illustrations) is the work of Professor Sir R. H. Biffen and of F. L. Engledow. Among the topics dealt with are the following : Mendelian heredity ; linkage ; chromosomes ; forms used for crossing ; ge-

neral methods of breeding and the propagation of hybrids ; the yield problem ; straw ; lodging ; rusts and the breeding of disease resisting forms ; the work of the Home-Grown Wheat Committee ; effect of soil on quality ; effect of manuring ; tests for ' strength ' ; the introduction of the Yeoman Wheats (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 1 London, 1926).

466. **Great Britain : Electro-Culture Investigations.** — The Electro-culture Committee has presented to the Ministry of Agriculture its Eighth Interim Report, dealing with its work during 1925. Previous reports on the work which the Committee has carried out since 1918 showed that under field experimental conditions an increased yield of 20 per cent. on the average might be expected when certain spring crops were subjected to high tension discharge (10,000 to 20,000 volts), and that under both field and pot experiments electrification has accelerated reproductive growth much more markedly than vegetative growth. (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 2. London, 1926).

467. **Great Britain : Scholarships given by the Ministry of Agriculture.** — Seven research scholarships in agricultural and veterinary science tenable for three years are offered, worth £ 200 per annum, while extra allowances may be made for travelling and subsistence for periods abroad. In addition there are offered five tenable for two years, for the same amount as the former, intended for students who propose to take up posts as agricultural organisers, teachers, or lecturers in agriculture, etc. In addition grants for amounts not specified are offered in aid of scientific investigations bearing on agriculture to be carried out in England and Wales during the academic year commencing October 1, 1926. (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 2. London, 1926).

468. **India : Creation of an Imperial Forest Service College at Dehra Dun.** — The buildings of the Forest Research Institute at Dehra Dun are to be converted into a college for students wishing to enter the Indian Forest Service. Twelve such probationers will be admitted each year, and as the course will be a two years practical course, the number of students in residence at one time in this Imperial Forest Service College will be twenty-four. It is hoped that it will be possible to open the College in November of this year. (*The Indian Forester*, Vol. LIII, No. 4. Dehra Dun, U. P. India : 1926).

469. **India : Reports on Work in Agricultural Science in the period 1924-25.** — The Government of India (Central Publication Branch) has published in one volume the Scientific Reports of the Agricultural Research Institute at Pusa, covering the work done in agricultural botany, chemistry, bacteriology, mycology, in phytopathology, entomology and cultivation methods. There are also included the Reports of the Imperial Dairy Expert, the Physiological Chemist, the Government Sugar-cane Expert, dealing mainly with questions of the breeding of varieties of cane, and the Report of the Secretary of the Sugar Bureau on agricultural, industrial, commercial and statistical aspects of sugar cultivation.

The whole is prefaced by a general and administrative report by D. CLOUSTON and C. S. HENDERSON, director and deputy director of the Institute. (Scientific Reports of the Agricultural Research Institute, Pusa ; including the

reports of the Imperial Dairy Expert, Physiological Chemist, Government Sugar-cane Expert and Secretary, Sugar Bureau, 1924-1925, pp. 163, 8vo; with appendices. Calcutta, 1925).

470. **Australia : Experimental farms in South Australia.** — The Department of Agriculture of South Australia has published in No. 193 Bulletin some records on the work done by various experimental farms in its area. Mr. ARTHUR J. PERKINS, Director of Agriculture, has drawn up the report on Turretfield Demonstration Farm which has been since July 1921 worked on purely commercial lines. The report which relates to the period 1 April 1924 to 31 March 1925 is in the main confined to balance-sheet considerations and a close analysis of the cost of various farming operations. The farm consists approximately of 1,262 acres of arable land and 327 acres of rough hill grazing, whilst about 15 acres are occupied by buildings yards, plantations, etc.

Mr. L. J. COOK, Manager, is responsible for the report on the dairy herd of Ayrshire cattle belonging to the Kybybolite Experimental Farm. These pedigree and graded cattle were purchased some time previously in Victoria, forming the nucleus of a herd intended to test the possibility of the district for dairying. The climatic conditions and the natural forage of the district led to the choice of this hardy Scotch breed, and they are continuing to prove that they can stand very well the comparatively cold and wet winter conditions of Kybybolite.

Another reports has also been drawn up by Mr. COOK on the crops obtained on the same farm which covers an area of about 100 acres in the Hundred of Binnum.

Mr. W. J. SPAFFORD, Chief Agricultural Instructor and Mr. S. C. BILLINGHURST, Manager, have drawn up a report of the Eyre Peninsula Experimental Farm chiefly dealing with the crops obtained in 1924. This farm consists of 3041 acres including 1200 of arable land. The greater part of the farm will also be capable of convertion into arable land after removal of the natural growth.

The Booborowie Experimental Farm covers 1484 acres and is situated 120 miles north of Adelaide at an altitude of 1200-2000 feet. In lies in the centre of a very good district which contains land : (1) suitable for cereal growing, (2) for clover without irrigation (and lastly, 3) some first class natural grazing land. The report on this farm is made by the Manager, Mr. E. A. BRISTOW.

This Departmental Record also includes a report by Mr. L. SMITH, Manager of the Veitch's Well Experimental Farm. This farm is situated in the Hundred of Allen, 158 miles from Adelaide and consists of about 3800 acres, the bulk of which is sandy. (Department of Agriculture of South Australia. Bulletin No. 193. *Records of some Departmental Work.* Adelaide, 1925).

471. **India : Calendar of the Forest Research Institute and College, Dehra Dun.** — A new edition of this Calendar has just been issued containing a short account of the College and its history, regulations for the various courses for forest officers with their respective syllabuses. Application may be made to the Manager; Government of India, Central Publication Branch, Calcutta, Price, Rupees 5, annas 6.

472. **Australia : The Waite Agricultural Research Institute, South Australia.** — This Institute has been founded by the University of

Adelaide for the purpose of carrying out agricultural experiments and enquiries. Its establishment was made possible by a bequest of £ 100,000, which the late Peter Waite, a large sheepowner, left for the purpose to the University. The South Australian Government has supplemented this endowment by a annual grant of 5,000 pounds sterling. The Institute is situated in Glen Osmond, $3^1/_2$ miles from Adelaide on an area of 300 acres of fertile land. The research work will be carried on in respect of agricultural science in general and in particular agricultural chemistry, phytopathology and plant breeding. (Communication made to the International Institute of Agriculture by the Board of Management of the Waite Institute).

473. **Italy : The Turin Station of Agricultural Chemistry.** — The "Notiziario Chimico-Industriale" which was first issued in January of this year has a special column giving information on the Italian Chemical Experiment Stations. In No. 3, March 1926, there is a notice of the Royal Station of Agricultural Chemistry at Turin, which is one of the most complete in Italy and is at present under the direction of Prof. FRANCESCO SCURTI. It is divided into five sections relating respectively to : (*a*) research work ; (*b*) analysis ; (*c*) adulteration ; (*d*) the agricultural industries ; (*e*) questions of agricultural science.

The first or research section is engaged on the various questions relating to the improved utilisation of agricultural land and is of a definitely experimental nature. At the present time some of the problems under consideration form part of a vast programme agreed upon at a congress of the Agricultural Experiment Institutes, held in Rome on 3 February 1925. Such for example is the enquiry into *soils with irregular rotation*, which involves the systematic examination from the point of view of their acidity or alkalinity of all the soils of Italy, the Turin Station undertaking the enquiry into the soils of Piedmont, Liguria and Northern Sardinia ; the enquiry into the *general composition of soils for the compilation of the agro-geological map of Italy* : the *enquiry on phosphatic fertilisers*, etc. For these studies the Station possesses the most modern equipment of scientific instruments and has in addition an excellent specialised library.

The second section, dealing with analyses performs an important service for the public and every year thousands of agricultural products and by-products are examined. With a view to securing rapidity and precision, a special building is available for this Section, in which each room is organised for a given class of product, analysis of phosphatic fertilisers, electro-chemical analysis, etc.

The third or adulterants section keeps special watch over the adulteration of the various agricultural products, and in view of the extension of vine growing in Piedmont, carries on a continuous investigation of all the musts and natural wines of the provinces of Turin and Novara. Two special departments ore respectively engaged on the œnological examinations and on examinations af fats and oils.

In the fourth section, that of the agricultural industries, a study has been made of the problems especially involved in the preservation of agricultural products, the scientific utilization of the residues of the rural industries, the purifying of the different products, etc. The large experimental equipment of the Section makes it possible to carry on investigations on a scale which is

semi-industrial. In addition to other mechanical appliances it possesses a refrigerating plant of improved type, of 10,000 freezing unit power, and a large desiccator on the Passburg system.

The fifth or agricultural science section has been recently established and has the use of an experimental holding of about 8 hectares. At the present time, research is being conducted here as also at the Royal Station of Agricultural Chemistry at Rome and at the Portici Laboratory of Agricultural Chemistry, on the influence of light on the growth of cereals. (*Il Notiziario Chimico-Industriale*, Year 1, No. 3. Turin, 1926).

474. **Italy : Work of the Royal Experiment Station, Reggio Calabria, in connection with the Manufacture of Essences and Derivatives of Citrus Fruits.** — For several years measures have been taken to encourage the essence industry in Calabria and Sicily, and to direct the cultivation of those plants which together with citrus fruits are of importance to the perfume and other similar branches of industry. The Reggio Calabria Station has also paid special attention to the analysis of citrus fruit essences, and this work is gradually developing. In fact the number of the analyses made during the season December-April were 1500 in 1920; 2000 in 1921 2400 in 1922; 2700 in 1923; 2300 in 1924 besides other analyses of citrus juices and citrates, etc.

Parallel with these studies and researches into methods for production of essences, the Station has conducted others on the essences from the natural flora of the territory of Reggio (*Calamintha nepeta*, *Mentha pulegium* L., *Mentha acquatica* L., *Rosmarinus officinalis* L., *Origanum vulgare* L., *Artemisia arborescens* L., *Artemisia variabilis* Ten., *Inula graveolens* Desf. Detailed accounts are given in the monographs published by the Station. In 1921 the cultivation of aromatic plants was initiated in the experiment field situated in the immediate vicinity of Reggio. The various crops are as follows: *a*) plants adapted to the climatic and other conditions offered by the experimental fields and therefore making it possible to make deductions of economic value: rose, jessamine, tuberose, jonquil, hyacinth, etc.; *b*) plants cultivated for the sole purpose of multiplication and distribution to suitable Stations; thyme, hyssop, balm, marjoram, mint, sage, etc. Recently the Station has obtained another experimental field at S. Stefano di Aspromonte at an altitude of 1000 metres. In the current year the extraction by means of volatile solvents of the plant essences most prized for perfumes and most remunerative has been undertaken: orange flowers, acacia, rose, hyacinth, jonquil, etc. (*Bollettino Ufficiale della Regia Stazione sperimentale per l'industria delle essenze e dei derivati degli agrumi*, Year I, No. 1-2. Reggio Calabria, 1926).

475. **Italy : Travelling Cinema for Agricultural Instruction.** — In consequence of the good results obtained from the courses of agricultural instruction given with the help of cinematographic projections in numerous centres of Latium and in the province of Grosseto, on the initiative of the *Opera Nazionale dei Combattenti*, this institution will extend the same experiment to other regions of Italy beginning with Sardinia. The *Opera Nazionale* has had special motor lorries built, completely equipped for the projection of films in the open air, each fitted with its own dynamo, for special use in localities where the electric light is not yet installed. (From the Italian daily papers).

476. **Italy : Poultry Breeding Experiment Station.** — The Poultry Observatory and Bee Keeping Station with headquarters at Diano Marina (Imperia) will now be known as the Poultry Breeding Experiment Station (" *Stazione sperimentale d'avicoltura* "). At the present it possesses more than thirty selected breeds of poultry, bred under conditions calculated to insure purity. (*Giornale di Agricoltura della Domenica*, XXXVI, No. 21. Piacenza, 1925).

477. **Italy : Royal Experimental Station for the Food Preserving Industry Parma.** — This recently established station has a chemical and bacteriological laboratory for the discovery of frauds or defects in the elaboration of food stuffs and also an experimental laboratory in which investigations and enquiries will be carried out on an industrial basis. The work of the station will be to make generally known new products and new methods of preparation, to investigate new sources, of food supply, and to train the experts for the industry in question. (*L'industria italiana delle conserve alimentari*, year 1, No. 4. Parma, 1926).

478. **Norway : Soil Science Researches.** — In this station such researches began in 1908 on the initiative of the " Royal Society for the progress of Norway " (" *Kgl. selskap for Norges Vel* "), which consists of a soil Science Committee of 3 members with a provisory working staff. This Committee remained active till 1921, when its functions were assumed by the State, which transferred it as a government organ for soil science researches (" *Statene Jordundersökelse* ") to the Norwegian High School of Agriculture (" *Norges Landbruksho Iskole* "). Investigations have principally been made to ascertain the condition of Norwegian lands and the preliminary results are published in special bulletins (" *Jordbundsbeskrivelserne* ") that have actually reached their 23rd number. On this subject it is intended to publish a general description of the 18 counties (" fylker "). The description of the lands in the county of Ostfold is nearly finished and the study of other counties has been commenced.

Researches are also being made on particular questions such as the acidity of the soil in various Norwegian regions, published in the " Tidskrift for det norske landbruk ", and the profile of the various lands. The first part of these studies on the profiles has been published in the " 3 Nordisk Jorbrukeforskring No. 5 of 1925 and refers to the " Ostfold " region.

The Director of the " Statens Jordundersökelse " is Prof. Dr. K. O. BJORLIKKE aided by an assistant and a permanent official who is also lecturer at the Norwegian Agrarian High School. In the year 1924-25 the director had besides 8 other collaborators. In 1925 a Norwegian Section of the International Society of Soil Science was formed. It is composed of 90 members, with Prof. BJORLIKKE as president and Prof. J. LINDEMANN as secretary and treasurer. (Prof. K. O. BJORLIKKE. Beretning om Statens jordundersökelse for årene 1924 og 1925. *Meldinger fra Norges Landbrukshöiskole*, Vol. 1-2. Oslo, 1926).

479. **Russia : Introduction of new crops into the Soviet Republic.** — The Institute of applied Botany having its seat at Leningrad, has organized a series of expeditions to tropical and subtropical countries in order to import into Russia seeds of cereals and other plants that do not exist in the Republic. Professor VAVILOV, director of the Department for Large scale Farming, v i

sited the Mediterranean archipelago, Egypt, Abyssinia, Syria, and Palestine to make enquiries into their methods of cultivation of barley, flax, beans, etc. Last year the same Professor had imported into Russia about 7000 samples of seeds from Afghanistan. Prof. BURASOV is studying the cultivation of potatoes, tomatoes, maize, the sunflower, etc., in the Western Andes (South America). Prof. VORONOV is making enquiries in Brazil in order to study the type of rubber plants that can withstand a hard climate. (*Science*, v. LXIII, No. 1637. Washington, 1926).

Agricultural and Scientific Associations and Institutions.

480. **An International Wine Bureau.** — Signor S. E. ROSSI, Italian Minister of Commerce, as early as 1916 had formed the idea of calling an international conference of the wine exporting countries. The first conference however took place in Paris from 4 to 6 June 1923 and was attended by delegates of Spain, Greece, Italy and Portugal, and was followed by a second conference also at Paris, from 30 June to 5 July 1924 at which, in addition to the States above named, representatives attended from Austria, Chile, Hungary, Luxemburg, Mexico, and Tunis. In the course of these two meetings a scheme for establishing an *Office international du Vin* was outlined. At the present time and in consequence of an international agreement dated 29th November, 1924, a bill has been brought before the French Chamber of Deputies for the approval of this agreement, establishing the Bureau in question with headquarters at Paris. (*Annales de Falsifications et des Fraudes*, year 19, No. 209. Paris, 1926).

481. **Brazil : Work of the Commissão do estudo e debellação da praga caféeira in the State of S. Paulo.** — In consequence of the alarming spread during these last few years of the beetle *Stephanoderes coffeae* in the coffee plantation of the State of S. Paulo there has been established by Law No. 2020 dated 26th December, 1924, a Commission for the study of this pest and its control. This Commission is attached to the "*Secretaria da Agricultura, Commercio a Obras Publicas*".

In accordance with the duties entrusted to it the Commission, under the presidency of Dr. Arthur NEIVA, has promptly undertaken the scientific and practical study of all the questions relating to the life history of the insect, commonly called in the country "brocha do cafe", the immense losses caused by it, and the measures for its control.

The work so far accomplished by the Commission is recorded in a series of fifteen leaflets, fully illustrated, some of a technical character but the greater part drawn up with a view to propaganda, and diffusion of information. The control measures thus organized under the direction of the Commission have proved remarkably successful in dealing with the pest, which had threatened the most important agricultural resource of the State of S. Paulo.

482. **China : Fisheries protection in Kiangsu.** — In this province a Kiangsu Coast Volunteer Corps has been formed for the protection of the fisheries and coast navigation. The Corps has at its disposal two steamers and twenty armed light vessels. The Corps has headquarters at Woosung and will undertake experiments in regard to modern fishery methods. (*The Lingnam Agricultural Service*, Vol. 3, No. 1. Canton, 1925).

483. **France : The Archives of the Department of the Agricultural Services.** — P. DEMARTY, director of the agricultural services of Tarn-et-Garonne, has explained in the *Bulletin de l'Office de Renseignements Agricoles.* (No. 7, 1926) the way these archives are put together, starting from the principle that the extension of the services in question in the different departments of France makes necessary a systematic classification of the numerous documents relating to them. In this way uniformity and continuity of policy will be made possible for the successive directors of the services, as they will have at their disposal the records as established by their predecessors over a long period of time. The work of DEMARTY is eminently practical and deals with the formation of files, of inventories, of the practical classification of both files and lists, as also of the more bulky publications, catalogues, etc.

484. **The Sheep Union of North Africa.** — Full reports have been published by the administrative council of this society whose headquarters are at Paris on its activities in 1925. The reports show how the Association has taken very great pains to develop and modernize the methods of marketing in North Africa, and with this aim two separate societies have been formed :— "The Shearing Society of North Africa" (*Société Nord-Africaine de Tonté*), which aims at promoting mechanical sheepshearing in North Africa, and at classification and proper packing of fleeces, and "The North African Society for Public Sales" (*Société Nord-Africaine de ventes publiques*) formed for the purpose of introducing into North Africa the same system of sales by auction that have rendered such excellent service to the wool markets of the world.

The Sheep Union of North Africa has also organized special sections for Morocco, for Algeria, and for Tunisia, which are supported by the experts and by the governments of the three respective countries. They have thoroughly studied the chief improvements which need to be introduced into sheepfarming in such countries and have drawn up a special programme to insure their gradual realization. Again they have investigated the question of the production of fine quality wool, which is indispensable to the industry of France and have therefore planned with their agents in Australia and the Cape for an early importation of Merinos.

The report is accompanied by letters from the Minister of Commerce, the Governor General of Algeria, and the Residents general in Tunisia and at Rabat, recognizing the need for and the general interest of the Society activities. (*Union Ovine de l'Afrique du nord. Rapport du Conseil d'Amministration* 1925, p. 16, large 8vo. Paris, 1926).

485. **Great Britain : Improvement of Agricultural Land.** — The sum of £ 1,000,000 has been allocated by the Ministry of Agriculture for the purpose of aiding drainage schemes for the improvement of agricultural land. The financial facilities afforded under this programme are to be extended only to approved schemes submitted and carried out by statutorily constituted Drainage Authorities, and generally speaking, grants will be limited to an amount not exceeding one-third of the final net cost of the work. In exceptional cases, however, the Ministry has authority to provide up to one half of the cost of the work. (*The Journal of the Ministry of Agriculture*, Vol. XXXIII, No. 1, 1925).

486. **Great Britain (Barbados) : Department of Science and Agriculture.** — This new Department appears to unite under one Administrative Head the activities of the Department of Agriculture, the Island Professor of Chemistry and the Department of Agricultural Science at Harrison's College. An Advisory Board of Agriculture has been formed, consisting of one member of the Legislative Council, two members of the House of Assembly, the President of the Agricultural Society, and the Director of Agriculture. The staff is to be appointed by the Governor and will consist of a Director of Agriculture, an assistant Director and Botanist, an Entomologist, an assistant Agricultural Chemist, and a Lecturer in Natural and Agricultural Science. (*Tropical Agriculture*, Vol. III, No. 4. Trinidad, 1926).

487. **Organisation of Veterinary and Zootechnical Services in Turkey.** — The Veterinary Service forms part of the Ministry of Agriculture possessing its own autonomy. It is divided into three sections :— *Epizootic* section possessing two general inspectors ; *Scientific Establishments* (veterinary school, serotherapeutic institutes, breeding establishments) ; *Zootechnic* section with one general inspector. At the head of each section is a veterinary officer with two secretaries under him. The establishments under its supervision are : 1) the Bacteriological and Serotherapeutic institute of Dendik ; 2) the Pathological Laboratory of Erzindjian ; 3) a Central Bacteriological Laboratory ; 4) a Pathological laboratory ; 5) the Breeding station of Karadja-Bey near Brussa ; 6) the Stallion depot of Eski-cheir ; 7) the Stallion depot of SIVAS.

There are also 22 other stallion depots in the different departments and finally the schools.

Before the war there were two veterinary schools at Constantinople, one civil, the other military. Since the armistice the military school has ceased to receive direct recruits, has become a practical school of the military veterinary service and only accepts students who have previously received a diploma in the civil school.

For civil veterinary service Turkey is divided into 72 departments, for each of which there is supposed to be a director, though at the moment owing to scarcity of staff, only 60 departments are so provided. The service also comprises 95 local veterinary officials, 50 country officers, and 25 slaughter house inspectors. (*Revue Générale de Médecine Vetérinaire*, Vol. XXXV, No. 414. Paris, 1926).

Congresses and Conferences.

488. **Sixth International Conference of Ornithology, Copenhagen, 24-29 May, 1926.** — Held under the patronage of H. M. Christian of Denmark. Five sections : 1. Systematic ornithology, geographic distribution, palaeontology ; 2. Anatomy, physiology, heredity, evolution ; 3. Biology ; Ecology and migration of birds ; 4. Oology, nest building ; 5. Protection of birds and bird breeding. The International Institute of Agriculture was represented by Baron ROSENCRANTZ of the Danish Bureau of the Institute at Copenhagen.

Among the principal communications relating to agricultural provi-

sions the following may be mentioned :— Dr. GRÖBBELS, " Researches on the digestive processes of birds ", " On the specific weight and the chemical composition of birds eggs ", with special reference to hatching; — Dr. SCHENK, " Fat and Lean years in the world of birds " ; — Dr. F. H. CHAPMAN, " The Panama island of Barre Colorado as a station for the study of tropical bird life " ; — Dr. Rud. ROST, " Bird migrations in winter " — G. T. PEARSON, " Protection of birds in North America " ; — Prof. SCHOENICHEN. " The present position of bird protection in Germany ";

489. **International Commission on the Embellishment of Rural Life, Brussels, July, 1926.** — Subjects discussed : 1. Statement of the object of the provincial commissions for the embellishment of rural life ; 2. Examination and discussion of the rules of the International Commission ; 3. Embellishment of rural life in the family, the school and in social life ; 4. Organization of the next International Conference.

490. **First International Cotton Congress.** — This report appears in Vol. III, No. 12, 1925 of the *Cotton Bulletin*. The Congress was held in Vienna from 4 to 6 June 1925 and was attended by 320 delegates of 21 nations. Among the more important resolutions should be mentioned the appointment of an International Court of Arbitration for the settlement of disputes in cotton circles. Arbitrators were appointed for fifteen nations.

491. **Report of the Tea Congress and Exhibition at Bandeeng Giava 21 to 26 June, 1924.** — This report has been published in an attractive form by the Experimental Tea Station at Buitenzorg (" Proefstation voor thee "). It contains the complete text of the numerous communications among which may be mentioned the reports of Dr. L. G. DEN BERGER, Dr. R. MENZEL and Mr. H. W. S. VAN HOOF of the losses caused by the Woodbubuk and other pests of the Tea plantation ; of Ing. A. GROOTHOOF, of Mr. D. C. SPARNAAY and of Ing. J. H. MULLER on the use of electricity on Tea plantations ; Messrs J. TANABÉ, BRAUND, MITCHELL, WILLIAMS on the tea industry and the trade ; Prof. A. LENDHER, Dr. L. REMFOUS on substitutes for tea from the point of view of adulteration of the product. Drs. J. J. B. DEUSS, M. KERBOSCH, C. P. COHEN STUART and of Messrs OEIJ TIAUWHOK, C. A. BACKER and A. KEUCHENIUS on various questions of cultural theory and technic. Mr. R. du PASQUIEZ reported on the Tea plantations of Indo China. (*Handeling van het Thee-congress met tenteenstalling geheyden te Bandoeng van* 21 *tot* 26 *Juni* 1924, 369 *pages large 8vo,* 47 *diagrams*).

492. **Hawaii : Meeting of the World Educational Federation, Honolulu, 1929.**

493. **Hawaii : Third Pan-Pacific Conference on Public Instruction, Honolulu, April-May, 1927.** — In connection with this Conference two other Pan-Pacific Conferences will be held : one on public recreation including roads, parks, means of transport, resorts, hotels, amusements, protection of forests, sports etc. ; the other on land reclamation including land settlement, irrigation, reafforestation, etc. These Conferences will be held under the auspices of the United States Government and the Pan-Pacific Union.

494. **Hawaii : Pan-Pacific Feminist Conference, Honolulu, July 1928.** — Four sections will be included : (1) health, specially the health of the

Mother and child ; (2) the economic position of women in industry ; (3) the welfare of childhood including training and instruction ; (4) women in the administration.

495. **Austria : Meeting of the Lower Austrian Chamber of Agriculture, Vienna, 8-13 March 1926.** — Items on the agenda : Dr. S. SCHLINTENBAUER, the position of German Agriculture ; Ing. GREIL, Agricultural fiscal Veterinary Inspector F. LENGSTEINER, herd books and functional tests ; Prof. F. STAMPFT, the future of the dairy industry in Lower Austria ; Ing. R. HENGL, grafting of vines ; Councillor J. LÖSCHNIG, cultivation and utilization of nuts ; Councillor J. LÖSCHNIG, the cultivation of cucumbers in Austria ; Dr. H. LEOPOLD, silos ; Ing. J. LEUTHNER, the potato and its industrial utilization ; Dr. H. KASERER, the depth to which land should be cultivated ; L. PORSCH, the question of sugar beet growing in lower Austria ; Forestry Lieut. O. IRLWECK, economic importance of game preserving ; Ing. K. POECKH, Pasturage ; Dr. G. SCHLESINGER, the professional sportsman and the public ; the protection of natural beauty and pasturage ; Dr. V. REICH and Councillor Jax the possibility of checking the economic distruction of mountain pastures ; Ing. H. LORENZ-LIBURNAU protection and export taxes ; in connection with forest property in Austria ; Ing. ALBRECHT, the extent to which the methods of Swiss alpine cultivation can be adapted to the conditions of Austrian alpine cultivation ; Veterinary Advisor L. HOCHMULLER, serious losses to Austrian stock breeding caused by the contagious diseases of alpine cattle, and methods of controlling and preventing such losses ; K. SCHMIDT, encouragement of poultry keeping on farms ; Ing. K. HESS, improvement of agriculture. (*Die Landwirtschaft*, No. 4, Vienna 1925).

496. **United States : 20th Meeting of the American Society of Agricultural Engineers, Tahoo Tavern, Lake Tahoo, California, 23-26 June, 1926.** — The various sections included : the farm ; electricity in agriculture ; land improvement and cultivation ; land clearing, and irrigation ; agricultural machines ; vocational organization ; instruction.

497. **France : Fifth National Congress on the cultivation of medicinal plants. Nantes, 12-22 July, 1925.** — This conference was organized by the *Comité interministeriel des Plantes médicinales et des Plantes à essences* and by the *Office National des matières premières végétales pour la droguerie et la parfumerie*. These reports have been prepared for publication by Dr. G. BLAQUE, pharmacist and secretary of the Office above mentioned. In addition to the report on the strictly official side of the Congress the following papers appear in it : M. BERTOYE, Mayor of Pornichet, " Aromatic plants on the sands of the Breton coast " ; Prof. P. GUERIN, " Gathering of sea weed in Brittany and utilization " ; M. REVAL, " Manufacture of iodine in Brittany " ; M. L. DANGUY " Utilization of the ancient salt marshes " There are besides special reports on the expeditions organized on the occasion of this Congress with the object of visiting the farm school of La Placelière and the cultivation of medicinal plants at Vannes ; at Sainte Anne d'Auray et Elven (domain of Kerleau). (*Compte Rendu du cinquième Congrès national de la culture des plantes médicinales*, 17-22 July, 1925, 51 pages, 8 vo, 5 diagrams. Lons-le-Saulnier, 1926. Price 10 francs).

498. **Rhodesia : Conference on the regulation on the export of maize, Salisbury, 11 March, 1926.** — Reported in the *Rhodesia Agricultural Journal,* April 1926.

499. **Italy: First National Congress of Manufacturers of Preserved Foods. Parma, 19 April 1926.** — The Proceedings of this Congress have been published in No. 1, 1925 of the *Bollettino della R. Stazione sperimentale per l'industria delle conserve alimentari.* The Congress members approved an agenda including the following resolutions : (*a*) that the control of the production and trade in preserved foods should be made stricter and extended to preserved products intended for export ; (*b*) that the Royal Experiment Station mentioned should be placed in a position to carry out its programme of work which, includes technical instruction.

500. **Tripoli : Congress of Colonial Agriculture. 15-17 April, 1926.** — The following papers formed the chief subjects of discussion: Prof. CRAVINO, The future of Agriculture in Tripolitania ; — Prof. DONADONI, Tobacco growing in Tripolitania and its future ; — Prof. LEONE, The forestry problem in Tripolitania ; — Dr. RAVA, The Irrigation problem of Tripolitania in its relations to agriculture and land settlement ; — Prof. TUCCI, The zootechnical question in Tripolitania ; — Dr. DE CILLIS, Wheat growing in Tripolitania ; — Dr. FANTOLI, Some meteorological factors in Tripolitania and their connection with agriculture. There was also a full discussion of the question of agricultural credit with a view to the cultivation of some of the more fertile territories of Libya.

501. **Italy : "Congresso Agricolo Pontino", Terracina, 30-31 May, 1926.** — Motions were approved relating to the reclamation of the Pontine Marshes, the technical direction of the changes in the systems of cultivation, olive growing, rice cultivation, forestry, the wheat problem of the Pontine Marshs, agricultural agreements, cattle, fisheries.

502. **Italy : Proceedings of the 1st National Italian Congress of the Milling, Baking and Sweetmeat Industries.** — Besides the official reports these acts include in their text the following communications : Prof. Dr. S. CAMILLA : The greatest, most reasonable and practical utilization of wheat by the industrial production of the flour called " Seia " (without bran, hygienic, nutritive) ; Ing. F. PAGLIANI : The cleansing of grain by peeling. Prof. Dr. S. CAMILLA : The necessity of instituting a Royal Experiment Station for milling, bread-baking and similar industries ; Prof. Dr. S. CAMILLA : Bread-baking ; Ing. S. SACERDOTE : Ovens and thermo-electric accumulation ; Prof. Dr. S. CAMILLA : Industrialization in the production of bread ; Ing. U. ORLANDI : The great automatic bread makers ; G. VECCHIOTTI : Yeast in the bread and pastry making industry ; Prof. G. ISSOGLIO : Phosphor-organic derivatives in bread-making ; C. A. di GATTIHARA : Bread-making with rice flour ; Prof. E. MONTI : Bread from high flour extraction and ripening processes in bread and flour. Dr. B. MARCHISIO : Mineralized nutritive bread ; Dr. C. FORMENTI : Aerated bread ; Dr. C. FORMENTI : The degree of humidity in badly baked bread ; Ing. A. ZURASCHI : Fixed prices and breadmaking ; C. MIGLIETTI : Starches and waste material in sweetmeats ; Prof. Dr. P. BALDI : Colours in the sweetmeat industry ; C. CIOCCA : Deterioration of sweet products during summer heat and its prevention. Ing. G. MARUCCO : Bread-making by machinery.

The volume consists of 300 pages in 8°, with illustrations. Apply to the "*Scuola per la panificazione ed industrie affini*" (Turin, Corso Stupinigi No. 11, Price L. 15 in Italy, L. 30 abroad).

503. **India : 13th Science Congress, Bombay, January 1926.** — This Congress was presided over by M. Albert HOWARD, Director of the Institute of Plant Industry at Indore and Agricultural Adviser to the states in Central India. In his address to the Congress Mr. Howard reviewed the beneficial results which have followed the practical application of botanical science to agriculture during the past quarter of a century. In India the improved types of wheat produced by the Pusa Research Institute already cover more than two million acres. The speaker mentioned the immediate beneficial results which follow the development of an irrigation system. In the case of sugar-cane it has been found that the most practical method of dealing with its fungus diseases is the production of new and resistant varieties. (*Tropical Agriculture*, v. III, No. 4, Trinidad, 1926).

504. **Uruguay : Reports of the annual Congresses of the Rural Federation.** — The "Federacion rural" of Uruguay, publishes every year reports on the Congresses that are held in different cities. This institution groups all the agricultural organizations including those of Uruguayan farm workers. From a prospectus published in the reports of the Congress of 1925 it appears that there are 47 of such organizations. The seat of the Institute is at Montevideo. For information : "*Federación Rural*", *Casa de los Rurales, Avenida* 18 *de Julio* 1919. *Montevideo.*

Exhibitions, Fairs, Competitions.

505. **Japan : Pan-Pacific Exhibition, Nagoya, Spring-Summer, 1929.** — The estimate for holding this exhibition involves an expenditure of 10,600,000 "yons" (1 "yon" gold = 2,585 fr.). The exhibition will be about twice as large as that of the "Peace Exhibition" held at Tokio in 1921. The pavilions and other buildings will cover an area of about 25 acres. The exhibition is organized under the auspices of the prefecture and the city of Nagoya, which will contribute to the cost of installation a sum of 3,000,000 "yens".

506. **France : National and International competition for motor propelled Fishing boats. La Rochelle, 14 to 19 September, 1926.** — This competition has been organized by the Under-Secretary of State for the Mercantile Marine. The fuel used by the motor-boats must be liquid, of a specific weight of more than kg. 0.810 the litre. Together with this competition and of the same kind there have been organized : an international competition for fishing-boats of small tonnage, petrol-driven ; inspection tests of fishing-boats propelled by other means, inspection tests of various apparatus for the same boats (capstans, windlasses, etc.) ; exhibition of marine motors and auxiliary apparatus of every kind.

For information apply to the Secretary for the Competition, at the *Sous-Secrétariat à la Marine Marchande*, 24, *Rue du Boccador, Paris.*

507. **International Exhibition of Horticulture. New York, 15-20 March, 1926.** — Information to be obtained from : Mr. John Young, 247 Park Avenue, New York.

508. **International Sample Fair. Havana, Cuba. 12-16 March 1926.**

509. **International Railway Exhibition, Santiago, Chile. September, 1926.** — On the occasion of the Third South American Railway Congress.

510, **XVII International Sample Exhibition. Lyons, France, 1-14 March 1926.**

511. **International Sample Fair. Salonica, Greece, 18-31 March 1926.**

512. **International Fair. Budapest, 17-26 April, 1926.**

513. **XIV International Sample Fair. Utrecht, Holland. 9-18 March 1926.**

514. **France: The Annual Colonial Exhibition of Marseilles.** — The administrative Council of the Colonial Institute of Marseilles has decided to complete the permanent Exhibition of Colonial products already installed in its Museums by starting again the special annual exhibitions that the Institute had organized from the time of its foundation, and which had been interrupted by the war and the Colonial Exhibition of Marseilles in 1922. The aim of these exhibitions will be to bring to notice a fixed number of colonial products each year from a productive, commercial and industrial point of view.

The first of this new series of exhibitions took place this years, from June 27th to July 15th, when special attention was paid to the following products: coffee, tea, sugar, vanilla and spices. By agreement with the Administrations and the Chambers of Commerce and Agriculture of Algeria, Tunisia and Morocco, the illustrative and documentary side was stressed, and it contained an important collection of photographs of great forests, geographic and economic maps, and plans of the principal works in the colonies together with all those other official and private documents that enable one to get a complete idea of the work undertaken by France in those countries. For information: *Institut Colonial, Parc Amable Canot, Marseille.*

515. **France: Manufacture of Farm tractors and petrol motors.** — The Ministry of Agriculture has suggested experiments to be held at the National Agricultural School at Crignon with the purpose of encouraging manufacturers who take part in the trials. *Bulletin de l'Office de Renseignements Agricoles*, No. 12, Paris, 1926).

516. **Morocco: Fair at Safi, 23 to 26 April.** — This fair included amongst other things: (*a*) a general competition for every sort of agricultural product from farms; (*b*) general competition of breeding stock (cattle, sheep, goats, pigs); (*c*) general competition for fat animals (cattle, sheep, pigs); (*d*) horse show; (*e*) exhibition-sale of agricultural industrial and motor car equipment; (*f*) a fisheries exhibition and implements for fishing; (*g*) farm competitions; (*h*) Congress of farmers from South Morocco.

517. **Morocco: Fair at Fez, 5-16 May, 1926.** — This fair included (*a*) the exhibition and sale of important products of Moroccan industry; (*b*) breeders' competitions; (*c*) shearing demonstrations; (*d*) auction sale of breeding stock; *e*) ploughing and cultivation competitions for mechanical and animal drawn implements, and demonstrations of the utilization of gas generating fuel in agricultural work and for the raising of water; (*g*) exhibition and sale of necessary implements generally used in agriculture; (*h*) " Mousseur " of all the tribes of Northern Morocco; (*i*) exhibition and sale of locally ma-

nufactured articles; (*l*) artistic exhibition; (*m*) horse races, et; (*n*) tourist excursions.

518. **Scotland: Grants in aid of Agricultural Shows.** — Since 1912, except for a period during the war, the Board of Agriculture for Scotland has administered a scheme for assisting agricultural shows in the crofting countries of Scotland. Assistance is given only to those shows at which there are classes confined to small farmers' stock, the term "small farmer" meaning occupiers of land of not over £100 rental or 100 acres in extent. The Board's grants take the form of a proportion of the prize money awarded, and in some cases part of the cost of the permanent equipment. With the object of encouraging small farmers to keep promising breeding animals special prizes are given in the cattle and horse classes. Keen local interest is shown by the small farmers in these shows, which have increased in number from six in 1909 to 37 in 1925. The reports of the judges indicate a steady progress from year to year in the quality of the animals exhibited whilst an improvement is also noted in the quality of the general stock of the districts apart from the competing animals. The shows subsidised in 1925 were held in Argyll, Inverness, Skye, Outer Islands, Ross, Lewis, Sutherland, Caithness, Orkney and Shetland.

Two years ago the scheme was extended to include shows confined to small landholders, occupying land of not over £50 rental or 50 acres in extent. Thus grants have been awarded to shows held in the counties of Berwick, Bute (Arran), Fife, Forfar, and Linlithgow. (*The Scottish Journal of Agriculture*, V. IX, No. 2, Edinburgh, 1926).

519. **Italy: "Cirio" competition for the chemistry or biochemistry of preserved foods. Naples.** — The Royal Academy of Physical Science and Mathematics of the Royal Society of Naples has offered a prize for competition to one or more of the best writers on any chemical or biochemical subject connected with preserved foods. The prizes amount to 5 000 lires. The competition closes 31 May 1927. Apply to the Secretary of the Academy (*R. Università di Napoli*, cortile del Salvatore).

520. **Italy: First Show of Sicilian Wheat Growing. Caltanissetta, September 1926.** — Seven sections: Collective regional exhibition; collective provincial exhibits; individual exhibits by cultivators of small, medium-sized and large holdings; educational exhibits; insecticides and fungicides; motor ploughs and animal tractor ploughs; machines and implements for the cultivation of wheat. Information: Cattedra di Agricoltura di Caltanissetta.

521. **Italy: National Fish Show. Porto S. Giorgio, Ascoli Piceno, August 1926.**

522. **Tunisia: Italian Sample Fair. Tunis, Spring 1927.**

523. **Italy: Italian Mining Exhibition, Rome, 1927.**

524. **Switzerland: Electric and Navigation Exhibition. Basel, July 1926.** — On the occasion of this exhibition a special sectional meeting was held of the World "Power" Conference for the discussion of the problems relating to power in so far as they were illustrated by the Exhibition.

525. **Uruguay: Cruising exhibition.** — A cruising exhibition is being organized to visit the principal American and European ports in order to demonstrate the progress made by Uruguay during a century of independent life.

Development of Agriculture in different countries.

526. **Brazil: Rice cultivation in the State of Santa Catharina.** — The area cultivated is about 9,300 hectares and produces about 17,000 tons of rice in the husk. The principal producing region is Blumenan, which yields 4,900 tons, then come Joinville with 2,400 tons and Ararangua with 1,950 tons. The climate of the State of Santa Catharina is very favourable to rice growing, as there are no dry seasons. The rice is planted in October and November, and is gathered in March-April.

The chief varieties grown are: — agulha, mattâo Carolina, Dourado, Japan and Honduras rice, Cattete and Cattetinho. The quantity of seed required per hectare varies from 90 kilograms if sown by hand to 40 kilograms if sown by seed drills. The harvest begins about 110 to 140 days after sowing. The yield is about 3,200 litres per hectare from irrigated lands and about 2,000 litres from dry lands. (*Brasil-Ferro-Carril*, 1925, No. 443, p. 288, Rio de Janeiro.

527. **Brazil : Rubber Growing in Para.** — The Para Rubber Growing Company (*Companhia Paraense de Plantaçâo da Borracha*) has been founded in Belem with a capital of 8,000,000 milreis for a period of 30 years with the object of developing the indigenous rubber producing forests. The Company owns 100,000 hectares of land on the left bank of the river Xingu in the municipality of Porto Moz. (*Brasil Ferro-Carril*, No. 445, p. 340, Rio de Janeiro 1926,).

528. **Brazil : Silkworm Breeding.** — The chief centre for sericulture in Brazil is the National Silk Industries Company Ltd. in the town of Campinas (State of São Paulo), which possesses every modern equipment for breeding and selection, also for spinning and weaving. The work is carried on under the expert management of Dr. P. ROSOLEN. Breeders in small centres are supplied with seed, and the cocoons are subsequently bought by the Company, and good prices paid. The sorts produced include primarily the Italian breeds, also Chinese, Japanese and Persian, and the period for rearing is from September to May.

The first yield from the *Institut Sericicolo* at Campinas in 1922-23 was 11,295 gm. of seed, out of which 2,408 gm. were from kinds previously found in Brazil, the remainder breeds imported from Italy. In 1923-24, 115,203 gm. of seed were produced, and in 1924-25, 248,800 gm. According to the calculations of the *Ispettorato agricolo* of São Paulo, by breeding 600 gm. of seed each time and repeating this eight times in one year, the annual yield of cocoons would be 960 kg.

Silkworm rearing is profitable in São Paulo for several reasons, the ready growth of the mulberry, the climate, the almost complete absence of disease in the mulberry or among the silkworms, and lastly the plentiful supply of labour. An additional encouragement is the certainty of sales to the Company. Mulberry plants and instructions are provided free by the Company to breeders.

The following kinds of silkworm are reared in the State of São Paulo: I. European. These spin elongated cocoons rather narrow in the middle, sometimes also nearly spherical ; the silk is of a fine yellow colour and of excellent quality. II. Chinese. These produce cocoons which are nearly spherical with silk of various colours. The two types most appreciated are gold and sil-

ver white. III. Japanese. Inferior to the Chinese as to cocoons and silk. IV. Less valuable kinds from Asia Minor yielding a whitish silk. (*Revista da Sociedade Rural Brasileira*, Year VI, No. 68, Ceres, Year II, No. 1, Sao Paulo, 1926).

529. **China : The Flood problem of Kwangtung.** — In *The Lingnaam Agricultural Review* (v. s. No. I, Canton, 1925) Mr G. W. OLIVECRONA, Engineer in Chief of the Board of Conservancy Works Kwangtung, discusses the important problem of the floods in Kwangtung. This question is certainly of great importance to the country and its solution is not easy when it is remembered that on a stretch of coast 60 miles in length, no less than four rivers flow into the sea ; viz, the West, the North, the Pearl, and East rivers, discharging, during the rainy season, about 2,000,000 cu. ft. of water per second. The Author discusses the principal means suggested as remedies against floods ; viz : afforestation, creating new outlets to the sea, storing the floods in reservoirs, cutting off bends and dredging of the river bed.

From the financial point of view the undertaking would be an immense gain to the people of the region. The cost of eliminating the danger would in round figures be $ 4.60 per *mow* (1 mow = about 0.15 Acres) of cultivated land. Considering that one rice crop represents a value of $ 25 to $ 30 per *mow*, an expenditure for necessary protection work of $ 4.60 is insignificant compared with the losses inflicted by one single flood. The scheme could be completed in fifteen years, during which time the farmers should pay 30 cents' per year per *mow* for flood protection work.

530. **Colombia : The possibility of Rubber growing.** — The regions best adapted for rubber plantations, where raw rubber can be procured in small quantities from the virgin forests, are especially the " Llanos " on the banks of the Pulumay the Caqueta, the Meta and Yapura rivers. These regions lie at a great distance from the ordinary means of communication and therefore are not easy to reach, except by the two routes formed by the Amazon and the Orinoco. A large quantity of rubber cannot therefore be expected from Colombia, the present yield being gradually on the decrease. According to the latest statistics, which are for 1923, the export of rubber amounted in that year to 310,000 kilograms with a value of 66,000 " pesos " while the statistics for 1916 showed 583 000 kilograms of rubber exported. In the period 1876-1900 the export of rubber amounted to the round figure of 1,850,000 kilograms. (*Der Tropenpflanzer* year 29. No. 4. Berlin, 1926).

531. **France : The Cultivation of Medicinal Plants in Brittany.** — In the course of the last National Congress on the cultivation of these plants, held at Nantes in July 1925, Prof. PERROT remarked that the import of these plants had fallen by 50 per cent. as compared with 1919, and that on the other hand the export had increased. This is due to the unflagging activity of the *Office National des Matières Premières* which in 1919 was set up in connection with the *Comité interministeriel des Plantes médicinales*. An intensive propaganda has been carried on by means of publications, conferences, free distribution of seeds and plants, the organisation of sub-committees, collaboration with schools, hospitals, experts, pharmacists, herbalists, horticulturists, etc., and the result has been that in the greater part of France there is no longer any necessity to import these plants.

At the present time in the region of Vannes (Morbihan), thanks to the acti-

vity of a local group, the *Flore médicinale* LA BRETONNE, fields have been sown with medicinal plant at Trussac, at the gates of Vannes (three hectares), at Sainte-Anne d'Auray (three hectares), at Ker-Hostin in the peninsula of Quiberon, and at Elven in the desmesne of Kerleau (ten hectares). A number of different kinds of plants are cultivated and a systematic study is made of them. The climate is favourable and the majority do well, including camomile, mallow, mullein, pepper mint, lavender, parsley).

The plants are dried as soon as gathered by a special hot air process which is very effective and rapid, and is installed both at Elven and Trussac.

M. BERTOYE, mayor of Pornichet, has tried experiments for acclimatizing Alpine lavender and rosemary on the so far entirely unproductive land of the dunes of Pornichet and Pen-Bron. The fields cover already 20 hectares (*La nature*, No. 2217, supplement, p. 137. Paris, 1926).

532. **Syria : Cotton growing.** — The most important fact of the 1925 season as regards cotton growing is a marked increase in the areas cultivated compared with the preceding year, the increase being noted not only in the whole area under cultivation but also in those areas planted with different varieties grown. This increase is shown in different degrees in all the States under mandate except the southern part of the State of Syria (ancient State of Damascus) in which, for reasons independent of the farmers, cotton growing is diminishing, although the growers, at the beginning of the season, influenced by the general movement had done their best to extend the areas planted.

The increase in the cotton growing area is 36.2 % compared with 1924, the figures being as follows : State of Great Lebanon 100 hectares ; State of the Alaonites 574 hectares ; State of Syria : vilayet d'Aleppo 36,507.5 hectares, region of Damascus 152.7 hectares, Sandjak of Deir 184 hectares, Sandjak of Alexandretta 1,857.6 hectares.

The produce is valued at 30,790 quintals divided thus : State of Great Lebanon 500 quintals, State of the Alaouites 925 quintals, State of Syria : vilayet of Aleppo 27 500 quintals, region of Damascus 305 quintals, Sandjak of Deir 25 quintals, Sandjak of Alexandretta 1530 quintals.

In spite of the fact of this increase there is still an absence of any definite direction such as would assist the growers to utilize to the full the natural resources of the country, with due attention to the particular requirements of the different varieties of cotton grown, and so get more profit from their efforts. It may be objected that cotton growing is still of too recent a date, and has been developed in districts too different in character for a uniform method of growing to be enjoined. At the same time it seems hardly wise, in view of the attachment to traditional methods of Syrian cultivators, to leave them free to use methods which might be contrary to their own interests as well as to the general interest of the country. Accordingly it seems preferable to teach them principles, the application of which would bring the most advantage, consistent with modifications which may emerge in practice. The working out of these principles is now quite practicable, since, as a result of the work accomplished in the last five years both by the Government Experiment Stations and by experiments privately made on plantations of varying size and under varying conditions, considerable data have become available for the agricultural services of the regions and from these much information of value for cotton growing

may be drawn. (From a report dated February 8, 1926 sent from Damascus to the International Institute of Agriculture).

533. **Andaman Islands : Forestry.** — In these islands there are about 2.200 sq. miles of virgin forests and it is calculated that two-thirds of these might be profitably worked. The quantity of timber that could actually be marketed is calculated to be about 10 tons per acre, a total of 8.960,000 tons, whilst the annual yield sustained would be about 100,000 tons. The formation of the country is extremely favourable to the cutting and shipping of timber. The Forest Department now employs about 1000 workmen in its two divisions in the North and South Andamans. During the last five years the average volume of timber exported has been only 6 000 tons per year, although last year it rose to 8,500 tons of which 1,850 tons were sent to Europe. The existing plant is capable of an output of 22,000 tons a year, but according to the *Gazette of India* even when this figure is reached there is still scope for a much larger development, in these islands given favourable market conditions. (*The India Forester*, V. LII, No. 6, Dehra Dun, U. P., India 1926).

534. **Algeria : Colonization during the ninety years 1830-1920.** — The first attempt at true colonization dates from a decree of Marechal Bugeaud in 1841, for all efforts made before had been frustrated by local insurrection. The regulations made by BUGEAUD were too military in character and colonization became a very heavy undertaking for the holders of the land, until a decree of April 26th, 1851 lightened the burden of the colonists and gave them under certain conditions the immediate property of the land.

Between 1841 and 1851 the Administration created about 126 towns and villages and made grants of land amounting to a total of 115,000 hectares (15,000 grants). Between 1851 and 1860 other 85 centres were formed and 250,000 hectares of land granted. After 1860 these grants or concessions were sold by auction, and financial companies obtained areas from 20,000 to 100,000 hectares. Between 1861 and 1870 21 centres were formed and 116,000 hectares of ground sold (chiefly to natives) : in the next ten years 400,000 hectares were granted and from 1880 to 1900 other 296,000 hectares were granted free (creating about 210 centres) on the condition of residence on the land for at least five years. From 1900 to 1921 the Governor General, can on the advice of the Government Council sell by agreement, by public auction, at a fixed price, or grant free, according to the interests of colonization. The grantee must personally cultivate and reside on his lot for 10 years, conform to the clauses and pay the price of the ground as fixed. Under certain circumstances he may transfer his obligations to a family. From 1901 to 1920 199 villages were founded and enlarged and 200,000 hectares granted, (L. R. La colonisation en Algérie de 1830 à 1921 : *Revue Scientifique*. y. 64, No. 1, 1926).

535. **Italy : The cultivation of Aromatic and Medicinal plants.** — " L'Istituto di Fondi rustici " at Rome has promised to form a Society to which it will belong and for which it will provide the greater part of the capital, which will be for the promotion of the growing of aromatic and medicinal plants in Italy. The Society has its headquarters at Florence and its direction is in the hands of an expert already noted for his activity in this matter. In the large business concerns that the Society possesses in various parts of Italy and its islands, the cultivation of easily grown aromatic and medicinal

plants will be started. In addition the society will look after the national harvesting of plants that grow wild in the different regions and organize the trade in them, both in Italy and abroad. Already centres have been prepared and the cultivation of many different kinds has been started : mint, lavender, staphisagria, hyssop, flea-bane, aniseed, soya, borage, camomile, cnicus benedictus, sage, pellitory, etc. (*Giornale di Agricoltura della Domenica*, Year XXXVI, No. 19. Piacenza, 1926).

536. **Peru : Measures for development of Agriculture.** — The irrigation work is progressing rapidly and definite plans are being elaborated. That of the *Pampas de Olmos* and the *Pampas Imperial* are of tremendous benefit to agriculture in those regions. Another special form of irrigation has been planned by organizing groups of persons of small means who give their labour and a small sum of money towards the necessary works. Experiment stations have been established at Cajamarca, Jauja, Acobamba and Moquegua, to improve the cultivation of wheat, and experiments have also been made in growing forage plants. In order to protect the crops in the lowlands from plant diseases regulations have been adopted dealing with the importation of sugar-cane seed and the obligatory fumigation of Tanguis cotton-seed. (*Bulletin of the Pan American Union*, Jan. 1926).

Miscellaneous.

537. **Argentine : The cotton trade of Argentine.** — The cotton commerce division (Division Comercial Algodonera) of the Ministry of Agriculture has published a propaganda book with the purpose of promoting the co-opetive sale of cotton. In the publication nothing of use is forgotten, starting from the principle that a rapid increase in the Argentine cotton produce depends chiefly on the institution of efficient business methods for dealing with this product. The most expert cotton merchants of the world show by their example that the method of co-operative negotiation practised in Denmark for all agricultural products, and partially in the United States, is also the best system to be adopted for cotton. The publication also described a scheme of co-opearative cotton negotiation adapted to the existing conditions of the Republic, and contemplates the creation of a co-operative " *Federacion Nacional* " for its sale. This will of course be formed from the different local agricultural associations to be found in all the cotton zones, and directed by the same cotton producers. The publication gives minute details and clearly describes the methods to be followed in order to institute the above named federation, and gives also an explanation of several adequate models. (Ernest L. TOTT. Negociación cooperativa cotoniera. *Ministerio de Agricoltura, Seccion Propaganda e Informes*, pp. 118 in 16° Buenos Aires, 1926).

538. **Brazil : Fruit Trade in Brazil.** — In 1924 Brazil exported 866 tons of pine apple (abacacis) ; 3,879,428 bunches of bananas ; 2,010 hundreds of cocoa nuts ; 750,685 hundreds of oranges, nearly all destined for the Argentine, and the value of which amounted to 15,500 contos. Brazil imports annually 2 600 contos of grapes; 2,000 contos of pears ; 3,000 contos of apples, the greater part of which come from the United States. (*Brazil Ferro Carril*, Year 1926, No. 444, p. 311. Rio de Janeiro).

539. **Brazil: The propaganda for the sale of Brazilian Coffee.** — For this purpose there exists in San Paulo "*L'Instituto del Caffé*" which has also an agency in Santos and a financial section which is occupied with demands for loans on the security of the stock of coffee deposited in the warehouses (armazens regulatores).

The Institute has a statistical and propaganda section, which permits it at any moment to estimate the situation of the product throughout the world. A short time ago an agreement was concluded with the State of Minas, others are proposed with the States of Rio de Janeiro and Espirito. Meanwhile it is aiming at a greater sale of coffee throughout the world, making use of extensive propaganda and granting bonuses to tradesmen who increase the sale of this article. (*Brazil Ferro-Carril*, 1926, No. 445, p. 320, Rio de Janeiro).

540. **United States: History of Agriculture in the Northern United States.** — Part of a series of publications on the economical history of America, published by the sociological and economical section of the "Carnegie Institution" of Washington. It describes the vicissitudes of agriculture at the time of the first colonists, rural economy in the XVIII century, the period of expansion and progress from 1800 to 1840 and the period of transformation from 1840-1860. It contains besides a critical bibliography, an index of authors, and a statistical appendix. (P. W. BIDWELL and J. I. FALCONER. *History of agriculture in the Northern United States*, 1620-1860; XII, 512 pp., 6 tab. 106 fig. *Carnegie Inst. Wash.* Pub. 358; 1925).

541. **United States: An Excellent American herbarium** has been given by Mr, E. D. Riley of Absecon, N. J. to the department of botany of Rutgers University. This collection contains ten thousand dried plants, valuable material from the southern part of New Jersey and a considerable number of plants from Ohio and California. A part of the collection was exhibited by Mr. Riley at the Colombian Exhibition. (*Science*, V. LXIII, No. 1636. Washington, 1926).

542. **China: Agriculture in China.** — Dr. Wilhelm Wagner has edited what may be called the first complete work on this subject. In about 700 pages in 8°, he reviews the Chinese agricultural zootechnical conditions based on an accurate study of the historical geographical and social conditions of the country. Dr. WAGNER who has been a teacher of agriculture and head of a section in the German High School of Agriculture at Tsingtau (China) develops the different arguments in a most rigorously scientific manner. The chapter on Chinese horticulture and fruit growing is by Dr. BERTRAM KRUG who was also a teacher in the above named school, and in the chapter on zootechnics the section on mule and camel breeding is from the pen of Dr. HANS BUCHMANN-GÖRLITZ who lived for a long time in China and Mongolia.

The volume is richly illustrated and divided into three parts: (1) Natural factors and their influence on agricultural production in China, (2) Economical conditions of China and their influence on agricultural production, (3) Chinese Agriculture in its technical organization and its consequences on private economy. An excellent bibliography closes the volume. (W. WAGNER, *Die Chinesische Landwirtschaft*, 683 pp. Lexicon format, 204 illustrations, 2 maps. Berlin, *Verlag Paul Parey*, 1926. Price, 42 R. M.).

543. **China: The production of Commercial Eggs.** — In this Republic there are actually 31 establishments occupied with the production of eggs and

amongst them five of the most important are situated at Shanghai and worked by strangers. They trade in preserved eggs. " The Chinese Egg Producing Company, Shanghai " is the one that does the most business. (*The Lignam Agricultural Review*, V. 3, No. 1. Canton, 1925).

544. **The United States : The navigation of the Missouri.** — The War Office has announced the assignment of two million dollars for work to be done in facilitating the navigation of the River Missouri, and has at the same time given the assurance that the sum will even be increased should the work be done with such rapidity as to urgently require additional funds. In this way, by the development and improvement of inland navigation, a great progressive movement will be realized for the regions drained by the Missouri, which will satisfy many of the agricultural needs of these same regions. (*The Agricultural Review*, V. XIX, No. 5. Kansas City, Missouri, 1925).

545. **The discovery of Vitamins.** — Casimir FUNK in an article published in *Science* (v. LXIII, No. 1635, 1926), criticises the views expressed by many research workers who attribute the discovery of vitamins to Sir Frederick G. HOPKINS. He concludes by saying that this discovery should be considered as the result of collective work of many investigators who besides Hopkins, include Bunge, Rohmann, Stepp, Eykmann, Schaumann, Suzuki (as well as Funk himself). As regards Hopkins, the important services rendered by him in the field of Biochemistry, Physiology including the discovery of tryptophane, Chemistry of the muscles etc., have placed him in the first rank as one of the most eminent exponents of Biochemistry.

546. **The book of Rural Life.** — This book is an agricultural encyclopedia and can be considered as a complete and characteristic account of North American rural life. The work consists of ten large volumes, and every phase of agriculture is exposed and treated in a simple and direct manner, as are also many other subjects relating to rural life. The book contains all that can possibly interest a farmer in the management of his farm. The ten volumes include altogether 8,500 original signed articles, with a total of 6,200 pages and 6,000 illustrations of animals, plants, and country scenes, besides 100 coloured plates. The authors of the various articles are 250, the signatures are those of experts in agriculture and of a few collaborators from among those authorities so numerous in America who interest themselves in agricultural and allied questions. At the end of the last volume is a general classification of the questions treated which is subdivided into the following sections: (1) Agriculture; (2) Domestic economy; (3) Hygiene; (4) Education and culture ; (5) Science; (6) Civil and commercial information.

A detailed index and, above all, notes on the special characteristics in the different articles ensures the quick discovery of the information required, and avoids repetition. Besides this the Publishing Firm proposes to keep the reader informed of the latest agricultural news by the publication of a yearly volume. The idea of such a book originated with John Bellow (of the Publishing Firm of Bellows-Durham Company of Chicago), who himself the son of a farmer, has left no means untried (at least he has spent on it more than 250 thousand dollars) to make his idea materialize. In short the print is excellent, the volumes bound in leather, the paper is very good, and the illustrations, are clear and neat. (*The book of Rural Life; knowledge and inspiration a guide*

to the best in modern living, 10 vol., 6200 pages, 6000 fig. and over 100 tables. Edit. Bellows-Reeve Company, 104 South Michigan Ave, Chicago Ill. (U. S. A.) 1925. Price (excluding U. S. and Canada) 79.50 dollars, duty and postage not included.

547. **Cuba : The Curtailment of Sugar-Cane cultivation.** — The Cuban government is studying measures to be issued with the aim of avoiding an excessive production of sugar. Such measures it seems would be favourably received by the proprietors of the sugar-cane plantations. (*The Agricultural Review*, V. XIX, No. 5, Kansas city, Missouri, 1926).

548. **The Herbarium of Auguste de Lugo.** — Mlle. DESAZARS DE MONTGAILLARD has left to the Laboratory of vegetable Biology of Fontainebleau the herbarium of her uncle Auguste de Lugo. This precious collection contains the dried plants of France, Spain, Algeria, the Canaries, and also the dried mosses of Husnot and lichens of Schaerez. The most interesting point is that it contains all the plants of the Pyrenees which having been gathered between 1820 and 1880 form a truly unique collection of its kind.

549. **Disappearance of the bread fruit tree.** — This tree (*Artocarpus incisa*) is beginning to disappear from the Pacific islands (Society Marquesas, and Fiji) in much the same way that the natives are also gradually disappearing. It is noted that the Marquesas islands at one time possessed whole valleys densely populated with these trees, valleys that are now being transformed into jungles. Dr. J. J. Webster of the Philippine islands learning that the bread fruit tree can be grown from pieces of the root, is making attempts at transplanting at Lamas in order to preserve this valuable tree. (*Nature*, No. 2722. Paris, 1926).

550. **Canada : The lading of cereals in the port of Montreal.** — During the last twenty years Canada, as is well known, has become the largest cereal producer in the whole world ; and the export of these products has risen from 35 million hectolitres in 1902 to 75 million in 1922. Therefore the problem of Canadian Cereal exports consists in being able to despatch the maximum quantity before the winter, that is before the ice blocks the ports. The Canadian ports and especially Montreal have therefore been specially prepared so as to be able to satisfy the exigencies of this immense traffic. Montreal lies about 1,600 kilometres inland and is connected with the sea by a canal that has a minimum depth of ten metres at low tide. The port possesses about 14 km. of wharfs. About a third of the export trade of Canada passes through this port and represents a value of about 700 million dollars a year. Four enormous elevators for cereals have been installed. One of them, the most important in the world, has the power of discharging 14,000 hectolitres an hour or 36 wagons. At the same time it can load a ship at the rate of 25,000 hectolitres an hour. The silos that it serves have a total capacity of 1,400,000 hectolitres. No. 2 elevator serves silos of a total capacity of 900,000 hectolitres and possesses a transporter system that serves in turn 20 berths and has a total capacity of 52,000 hectolitres per hour, and can also load two ships at the same time at an average of 12,000 hectolitres an hour. Besides this there are four metal towers on rails with elevators that have been provided for the discharging of ships coming from the Great Lakes. (*Génie Civil*, July 1925).

551. **New Zealand : Tree-Planter's Guide.** — The New Zealand State Forest Service has published a small volume containing practical instruc-

tion and information for sylviculturists. Directions are given in clear language and the publication is in every way an example of highly attractive propaganda for the preservation of the existing forests and for re-afforestation. The nursery plantations at Rotorua (North Island) and at Haner Springs (Canterbury), Tapanui (Otago) and Naseby (Central Otago) supply trees at moderate prices for the plantations. The guide has been re-edited, under the direction of Sir R. R. HEATON RHODES, Commissioner of State Forests and on the basis of experience gained in New Zealand during twenty five years of practical sylviculture. (*Tree-Planter's Guide*, 16 pp. Wellington, 1924).

552. **South Africa: History of Agriculture.** — In a manual entitled "Selected Subjects in the Economic History of South Africa", (Cape Town 1924) certain chapters are given by Mr. H. de Kock on agricultural progress and pastoral resources under the administration of the Dutch East Indian Company (1652-1795) as also on the agricultural conditions of the region from the beginning of the British occupation.

553. **Greece : The adoption of the Metric System.** — This system of measures came into force by law from 1 March 1926. Previously the kilogram had been adopted in the Greek Customs tariff as the legal measure of weight. In practice however the *oka* of 1.282 kilogrammes and the *oka* of about 1.30 litres continue in use. The metric measures of weight and capacity will not become obligatory till 1 March 1927, and in the meantime the Government has to institute at Athens an Office of Inspection for weights and measures.

554. **Italy : Application of Legislation with regard to Land Reclamation.** — A practical guide to legislation on land reclamation has been produced by Dr. ELISEO JANDOLO, Inspector at the Ministry of Public Works, in the form of a substantial article of some thirty pages, octavo, published in the *Annali dei Lavori Pubblici* Year LXIV, No. 2, 1926. This of course, refers to the law of 30 December, 1923, which cancels in the matter of transformation of swamps and marshland all such provisions as may previously have been in force but are not embodied in the new text.

The article contains a general survey of the provisions for land reclamation, as undertaken by the State or by the persons concerned, and for this purpose the schemes for land improvement are grouped under two categories.

Some general observations follow as to framing the statutes of the recently formed land improvement companies and as regards new schemes to be taken up by provincial or communal associations previously existing. There is next a practical demonstration of the conditions which determine in the various cases the concession of land reclamation schemes of the first category ; the technical and financial stipulations for any such concession ; the extent to which contributions will be required from the State, the provinces and the land owners respectively ; the assessment and collection of these contributions ; the guarantee for payment of them ; credit facilities ; financing of the work involved ; upkeep of works when constructed ; the processes by which the land is improved and transformed after drainage ; minor schemes of land improvement (in the second category) ; and the part taken in the work (as regards the Pontine Marshes) by the municipalities of Anzio and San Felice.

555. **Italy : Irrigation Services.** — The Hydrographical Service of the Ministry of Public Works has extended its activities to the utilization of water

for agricultural purposes with special reference to irrigation schemes, and has recently published a special study of the subject: *Le irrigazioni in Italia : notizie preliminari sulla estensione delle irrigazioni, sulle modalità di esse e sui prezzi praticati nelle diverse regioni italiane* (Roma, Libreria dello Stato, 1926), containing the results of investigations undertaken with a view to obtaining accurate knowledge of the conditions which at the present time determine the irrigation problem in Italy. The enquiry took account of the following factors : (*a*) quantity of water at present supplied per hectare in the various regions and in respect of the various crops ; (*b*) practical methods employed in irrigation, (length of time, systems of rotation, etc.) ; (*c*) units of measure applicable and charges to be made for water ; (*d*) estimate of water requirements for various crops ; (*e*) brief note with regard to the extent of the irrigated zones in the various districts of Italy.

The following reports are of special interest : — the report on the valley of the Po by Prof. GIANDOTTI and that by Eng. PALLUCCHINI on the region of the Veneto. These communications are prefaced by introductory considerations of a general character : Prof. E. EREDIA supplies a chart of the high-temperature conditions obtaining in the regions of Italy during the period when irrigation is practised (April-September), Eng. G. DI RICCO gives some statistics as to measurements of rainfall and Prof. G. DE MARCHI goes on to examine the principal results which the reports of the Sections establish in relation to the water supply conditions of the various divisions.

The point which is specially brought out is that the quantity of water supplied for agricultural purposes depends exclusively on the amount of water available and not on the actual requirements, there being frequently a wastage where water is in abundance and a shortage where it is difficult to provide an adequate water supply. Local habits and traditions have more weight than rational considerations in determining the ways and means of irrigation. The prices at which water is sold are apt to vary very much even in coterminous districts, at times they may be so high as to make it an economic proposition only to irrigate crops of a very high yield and at times prices are very low in relation to the various sources from which the water is tapped.

The data derived from observation of local practice with regard to the quantity of water actually necessary for various forms of cultivation are scarcely ever reliable since there is on all sides a tendency to consider as indispensable whatever water is available. Finally the examination of rainfall measurements establishes a fact which is perhaps contrary to the general belief, namely, that the differences between the amounts of rainfall during the irrigation period, and in the various districts are slight in comparison with the supply of water required for irrigation purposes. The volume provides also a number of illustrations and three charts of rainfall measurements for the different periods of the summer season.

556. **New Views on the Physiology of the Flower.** — Certain new views are being put forward on the importance of the floral envelopes in relation to their function which will undoubtedly modify the old view of SPRENGEL that the perianth acts as a kind of banner (vexilla) for purposes of attraction. Prof. GUSTAVO BRUNELLI, in a brief note remarks that there ought to be much wider circulation of certain studies such as those of BUSCALIONI and POLLACCI

on the anthocyanins especially from the point of view of the oxidases, since the principal function of the floral envelopes may be respiratory. According to the phylogenetic point of view this "*vexillary*" function would be grafted at a later time on to the respiratory functions of the flower, which would render more comprehensible the evolution of this organ, but it may be necessary to discard the theory of SPRENGEL as to the relations between forms, colours and scents of flowers and the animal world, in particular insects. (GUSTAVO BRUNELLI, *Funzione respiratoria e funzione vessillare del fiore*, 12 pp. small 8vo. Roma, 1925).

557. **Paraguay: Classification of Cotton.** — The Government has issued appropriate ordinances which are now embodied in a law providing for the creation of a State Department for cotton classification and in a decree fixing the grades of cotton in bale ready for exportation. Five categories are distinguished: I. Special; II. Good First Quality; III. First Quality; IV. Second Quality; V. Inferior Second Quality. The formalities of State inspection are duly prescribed, and it is provided that such inspection may be carried out, if so desired, in private concerns. The technical bases of the process of classification are also established. (*Diario Oficial*, No. 1155. 1163: 1925).

558. **Dutch Indies.** — The Commercial Section of the Department of Agriculture, Industry and Trade of the Dutch Indies has published a booklet in French carefully compiled and well illustrated with photographs, giving a concise but fairly complete account of the Dutch Indies, particularly in respect of agricultural and economic resources. Emphasis is laid on the importance of those islands in international economic relations, as supplying tropical products on a large scale and having extensive direct trade relations with a number of consuming countries, chiefly European. This issue of the manual is especially intended for circulation in France, Belgium and Switzerland, and the Commercial Section contemplates a subsequent publication of a more complete work with special reference to the economic aspect of questions affecting the Dutch Indies. (*Les Indes Néerlandaises*, pages 74, 16mo large, 26 photographs. No date).

559. **Dutch Indies: Centenary Publication on Cultivation of Tea (1824-1924).** — The Experimental Tea Station (*Proefstation voor Thee*) at Buitenzorg (Saxa) has produced a substantial series of articles profusely illustrated in a volume published on the occasion of the Tea Congress held at Bandoeng in 1925. The book contains an explanation of the various difficulties with which the cultivation of the product in question has had to contend during the period of a hundred years (1824-1924) and a survey of its development. It opens with three historical studies, Dr. C. H. BERNARD (Director of the General Experimental Tea Station) writes on the "Progress of the Cultivation of Tea in the Dutch Indies", — Dr. C. P. COHEN STUART (a Plantation expert at the Experiment Station) on the early days of Tea cultivation in Java; — H. C. H. DE BIE (Inspector of Agriculture) has a study on Dutch Tea Cultivation from 1830 1924, Other articles include a study by T. J. LEKKERKERKER (Inspector of Agri cultural Instruction) on two regional associations of tea planters, a contribution from a "Master Storekeeper" on the fluctuations of Java tea on the Dutch market, and one by D. LAGEMAN on the functions of the Tea Expert. — Dr. COHEN STUART in an article "Assam Versus China" deals with tea cul

tivation from the stand point of agricultural economics, while Dr. BERNARD presents the results of study and observation on the tea blight (*Helopeltis*), and Dr. J. J. B. DEUSS (Chemist at the General Experiment Station) comments on the conclusions of JACOBSON with regard to cultivation of the plant and on the development of the technical processes by which the product is prepared.

There are in addition some reminiscences by MM. W. P. BAKHOVEN, L. A. F. H. Baron Van HEECKEREN tot WALIEN, Dr. C. P. COHEN STUART, of the original conditions both of planters and plantations which led to the development of the tea wealth of the Dutch Indies, as also in conclusion a history of the Agricultural Association of *Soekabomi* by W. DE WOS and a history of the Experimental Tea Station by Dr. Ch. BERNARD.

The volume is completed by a very full bibliography and illustrated by some striking plates, several coloured. (*Gedenkboek der Nederlandsch Indische Thelcultur* 1824-1924. *Uitgegeven door het Proefstation voor Thee big Gelegenheit van het The congres met Tentoonstelling*, Bandoeng 1924, pages 242, 8vo, 42 plates *Weltevreden* no date).

560. **International Wine Trade from 1900-1925.** — At the Jubilee Congress of the " Comité international pour le commerce des vins, cidres, spiritueux et liqueurs in Paris " the " Fédération Suisse des négociants en vins " presented an extensive report on this subject with a wealth of statistical data and appropriate comment. The report dealt with the question under various headings-wine production, legislation in respect of traffic in wines in the various countries both as regards producers and consumers, the home marketing and consumption, import and export data, customs tariffs and excise duties levied on wine, teetotalism and its influence on the international traffic in wines, the organization of wine production and trade.

The conclusions of the report may be summed up as follows : (*a*) a better legal definition of the so-called *non-alcoholic* wines, prohibition of use of this or any similar description arising from the inclusion by different legislations under the definition " wine " of non-fermented grape-juice and the fermented products of quite different fruits ; (*b*) prohibition of the manufacture and sale of artificial wines ; (*c*) reduction of fiscal burdens on the wine trade ; (*d*) organisation against the Prohibition League ; (*e*) general propaganda throughout the world in favour of wine.

Journals and Reviews.

561. **Germany : Cheesemakers' Pocket book, 1926.** — Published by P. PAREY of Berlin, the 49th year of this well known German hand-book sees its appearance in two parts. The first part, in addition to the customary general calendar and diary, contains a handy technical summary of everything relating to the management of cows in milk and to the processes of cheesemaking. The tables have been compiled from recent statistics of the industry. The second part contains a complete list of addresses of cheese making and similar establishments in Germany, the information relating to over 10,000 firms, and a systematic survey of all those public institutions, which in the German Republic are promoting the science and industry of cheesemaking. In addition there will be found inserted the legislative and administrative provisions on

the subject. (*Milchwirtschaftliches Taschenbuch für 1926*. Year XLIX. Berlin, 1926).

562. **China : A New Agricultural Journal.** — Under the litle of " Lung Pao " a new journal has been published at Foochow, in Fukien, by the Union of Foochow Agricultural Associations. It contains articles in Chinese.

563. **United States : Some Changes in the Experiment Station Record.** — With the beginning of a new volume of this old-standing and valuable review, published by the *Office of Experiment Stations* of the U. S. Department of Agriculture, a number of changes have been made in the arrangement of part of the material handled, so as to make it more convenient and readily accessible to readers. While the Section on "Foods - Human Nutrition" will be continued and will include as before the fundamental studies which have always been associated with human nutrition, there will now follow immediately on it two new sections dealing with questions closely connected with home economics, one entitled " Textiles and Clothing ", and the other " Home Management and Equipment ". The first of these sections embraces studies of the handling and utilization of textile fibres and similar materials which were previously put haphazard among the articles on agriculture, forestry or farm production, as well as studies of clothing and laundering, for which no appropriate place has previously existed. Under Home Management and Equipment are included many of the farm home studies formerly classified under Rural Sociology and Agricultural Engineering.

The additional sections are obviously considerably broader in scope than the portions which they replace, and it is hoped ultimately to develop them with the growth of their respective subjects. Unfortunately, however, the total space available in the *Record* is now no greater than before. The last enlargement from 1600 to 1800 pages per annum was made in 1911, since which time the quantity of agricultural research has immensely increased, involving severe pressure on the space for abstracts. Only comparatively little expansion can therefore be expected on any subject, but it is hoped to cover as adequately as possible the studies made by the Department of Agriculture and the Experiment Stations. (*Experiment Station Record*, Vol. 54, No. 1. Washington, 1926).

564. **Italy : Special Number on Mulberry Growing and Silkworm Rearing.** — The fourth number of the current year of *L'Italia Agricola* is devoted entirely to the subject of mulberry growing and silkworm rearing in Italy, the articles being profusely illustrated. Among the contributors are V. ALPE : Changes in type of mulberries and silkworms in Italy ; — G. DRAGONI : General Survey of the world production and trade in silk ; — L. ARIMATTEI : The silk industry and trade in Italy ; — E. MALENOTTI : The great benefits of the mulberry rearing of silkworms ; — E. PARENTI : Ancient and modern mulberry cultivation ; — C. ACQUA : The technique of the production of the silkworm ; — R. GRANDORI : Problems of the Italian silkworm seed industry ; — L. CASTELLI : Failures in silkworm rearing in Italy ; — V. FIORUZZI ; Silk worm rearing on a permanent industrial scale ; — M. BATTAGLIA : Mulberry growing and silkworm rearing in Japan. In addition to letterpress, this number contains a table showing production of cocoons in the different provinces of Italy.

565. **Italy : Official Bulletin of the Royal Experiment station for the Industry in Essences and other products of Citrus Fruits, Reggio Calabria.** " *Bollettino Ufficiale della R. Stazione Sperimentale per l'industria delle essenze e dei derivati dagli Agrumi in Reggio Calabria* ,, — This is the title of a monthly review which has begun to appear in Reggio Calabria as from 1 January of this year. Besides original contributions, the Bulletin contains abstracts and economic and trade particulars. In the first two numbers there is a short account of the work of the Station done to encourage the preparation of citrus fruits essences, etc. The Bulletin is the continuation of the " Annali " of the Station of which two volumes had already appeared.

566. **Italy : " L'Industria italiana delle Conserve alimentari ".** — This is the title of the bulletin of the Royal Experiment Station which has been organised for the food preserving industry at Parma. It appears monthly, beginning with the January issue of this year. Annual subscription : Italy, Liras 20, other countries Liras 30. Offices, *Parma, Viale Faustino Tanara*, 21.

567. **Italy : Bulletin of the Royal Plant Pathology Station at Rome.** — A new series of the *Bollettino della R. Stazione di Patologia Vegetale* began in January of this year, showing the greater impulse which the directors of the Station, Prof. L. PETRI and B. PEYRONEL, are intending to impart to enquiries and investigations into phytopathological questions connected with Italian agriculture especially that of Southern Italy.

568. **Italy : " Il Notiziario chimico industriale ".** — This is a new review which is published monthly at Turin and is edited by a committee composed of persons directing the most important institutions of applied chemistry in Turin. Among those are Prof. BALDRACCO (R. National Institute for the Leather Industry) ; Prof. F. GARELLI (Institute of Industrial Chemistry at the Royal School of Engineering) ; Prof. L. MASCARELLI (Institute of Pharmaceutical Chemistry of the University) ; Prof. C. MONTMARTINI (Institute of General Chemistry at the Royal School of Engineering) ; Prof. V. SCURTI (Royal Agricultural Station) ; Dr. V. PREYER (" Fiat " Research and Inspection Laboratory) ; F. GROTTANELLI (Nobel Dynamite Company Ltd.). Annual Subscription : Italy, Liras 80 ; abroad, Liras 140. Business Office, Via Ospedale 20, Turin.

569. **Japan : Bulletin of the Chemical Society of Japan.** — The issue of this Bulletin began in January of the current year. Reports are published in their original form, English, French or German, and the Bulletin contains contributions sent to the Society, as well as original articles in Japanese. Chief Editor Jitsusaburo SAMESHIMA (Chemical Institute, Faculty of Science at the Tokio Imperial University). Annual subscription for 12 numbers : 4,00 Yen.

570. **Latvia : Acta Horti Botanici Universitatis Latviensis.** — This publication, otherwise known as *Latvias Universitates Botaniskà Dárza Raksti*, will appear three times a year. Editor : Dr. N. MALTA : *Riga, Kronvalda bulv.* 4, *L. U. botaniskà laboratoria.* The articles are published in German, English and Latvian.

571. **Czecho-slovakia : Annals of the Agricultural Academy.** — Under the title of Sborník českosloveuské Akademie Zemědělskč this is a new review of the progress of the agricultural sciences. The publication is divided

into two parts : Part A containing original contributions ; Part B abstracts and bibliography. Among the contributors are names of repute in agricultural science, STOKLASA, ERNKA, SMOLIK KOPECKY, KREJCI, CHEMLAI KRIZENECKY, REICH. The first number contains original articles by STOKLASA and BARES on the mechanical processes of the anaerobic respiration of the plant organs ; LASCA on cheese bacteria; NOVAK on the climatic and pedological types of Czecho-slovakia ; TAUFER on registration and records of the data of performances and heredity among the dairy cattle of Moravia ; KAS on investigations of the physics of soil science.

The annals are published in Prague. Price 24 Kc. (Apply, *Secretariat de l'Académie, Prague II, Jungmannova,* 18).

Personal.

572. Dr. J. C. ARTHUR, emeritus professor of " Perdue University ", has been appointed an honorary member of the Russian Botanical Society in the mycology Section, in recognition of his researches on mildews.

573. In the Portuguese Review " Brotoria " No. 1,1926, published at Caminha, an obituary notice appears on the Rev. JOAQUIN M. A. DE BARNOLA by the Jesuit father JAIME PUJIULA. director of the Biological Laboratory of Sarria. Father de BARNOLA who died in June 1925 has left works of an educational character on botany and mineralogy. The results of the important expeditions organized by the *Institución Catalana d'Historia Natural* of which he was president and by the *Sociedad Iberica Seccion de Barcelona*, of which he was permanent secretary, have been embodied in a number of valuable scientific notes and in the report entitled " Flora vascular del Principado de Andorra ".

574. The death is announcd of Prof. W. BATESON, director of the " John Innes Horticultural Institution " Merton, England. As is well known, Prof. Bateson was renowned as an exponent of Mendelism, and his works on genetics, particularly " Mendel's Principles of Heredity " occupy, a conspicuous place in the extensive contemporary literature on heredity and selection.

575. Prof. ANTONIO BERLESE, a well known worker in the sphere of agricultural entomology and of phytopathology, has been presented with a gold medal and honorary diploma by the Agricultural Society of Lombardy.

576. The wellknown horticulturist LUTHER BURBANK died on April 11th last at Santa Rosa, California, at the age of 77 years.

577. Sir THOMAS H. ELLIOTT, permanent Delegate of Great Britain at the International Institute of Agriculture, and Councillor of the British Embassy to the King of Italy, died in Rome last June. Sir Thomas was an expert in all branches of agricultural administration and for over twenty years was Secretary to the Ministry of Agriculture and Fisheries in London. His work in connection with the control of foot and mouth disease and other contagious diseases of stock was particularly effective, and his name will always be associated with the marked development of his Department which took place during the earlier years of the present century. His interest in the International Institute of Agriculture dated from the days of its foundation, and latterly

he was one of the most active and devoted members of the Permanent Committee.

578. Prof. ALOIS GROSS, director since 1904 of the *Landes-Ackerbau-und Flachsbereitungs-schule* of Schönberg, Moravia, and member of the Government Adjudicatory Commission for agricultural instruction, on which he did most valuable work, died on 15 March.

579. Prof. EDUARD HACKEL, the eminent Austrian professor of Agronomy, died at the age of 76. His works on plant classification are renowned. His fine herbarium was acquired several years ago by the Viennese Museum of Natural History.

580. Prof. S. C. HARLAND has been appointed Head of the Department of Genetics on the staff of the Cotton Research Station of the Empire Cotton Growing Corporation at St. Augustine, Trinidad. (*Tropical Agriculture*, Vol. III, No. 4, 1926).

581. EARL S. HASKELL of Tulane University formerly an official of the United States Department of Agriculture, has been appointed Director General of Agriculture for Persia.

582. A biographical notice of Prof. HEINRICH IMMENDORFF, director of the Institute of Agricultural Chemistry in the University of Jena, of the Thuringian Regional Institute for Agricultural Research, and of the Observatory of Fluvial Hydrography at Vacha on the Werra, appears in the *Die Landwirtschaftlichen Versuchs Stationen* review (No. V-VI, 1926) edited by Dr. ERNST MISCHE, the occasion being that of the twenty-fifth jubilee of IMMENDORFF'S work as director. The researches made by Prof. IMMENDORFF with E. KEMPSKI on Calcium cyanamide as a fertiliser, are well known, having been for the most part published in *Calciumcyanamid als Düngemittel*.

583. Counsellor Prof. Dr. KARL LINTNER died on 12 April last. He was a renowned teacher and investigator of the chemistry of enzymes, particularly those embraced by the technology of agricultural chemistry. Since 1896 he had been professor at the Higher Technical School of Munich.

584. JACQUES LOEB. The *Journal of General Physiology* has devoted one number (Vol. VIII, No. 4, 1926) to the commemoration of this illustrious scientist. A notice of the death of this physiologist appeared in an earlier number of this Review (No. 4, 1924) giving a list of his principal works.

585. Dr. CARLO DA MARCHESETTI director of the Botanic Garden and the Natural History Museum of Trieste, has died.

586. Prof. GIAN DOMENICO MAYER, Professor of Farm Engineering and one of the most eminent of the staff of the *R. Istituto superiore agrario* at Portici (Naples), died on 10 July. Prof. MAYER gave a certain special direction to the study of his subject, as may be seen from his works. He was anxious that rigidly technical treatment, necessary for the analysis of the various divisions of the subject matter, should be linked with other aspects of the problems of farm engineering, and that accordingly the inter-dependence of the technical side with economic, social questions and those of agricultural science should be realized.

587. The death has been announced of Prof. JOSEF MUNZAR formerly lecturer in the Higher School of Agriculture at Brünn and later in the Academy

of Agriculture of Tabor. The Czecho-Slovakian Agricultural Academy of which he was a member, publishes in its *Mitteilungen*, No. 2, Vol. 2, an article on his numerous scientific works.

588. A loss to the scientific circles of the island of S. Domingo has been occasioned by the death of Sir H. ALFORD NICHOLLS, C. W. G., M. D., F. L. S. He was well known as the author of the " Textbook of Tropical Agriculture ", and had done much to develop the Dominica Botanic Garden, which is now one of the most interesting of the West Indies. He was also Principal Medical Officer of the Island.

589. Dr. N. HJALMAR NILSSON, for 35 years head of the Swedish Seed Association and director of the Experiment Station of that Association at Svalöf, has died at the age of 69.

590. With the death of JOSEF NOLC on 20th March last Bohemia has lost an old expert in the genetics of barley. He had actively employed himself in the production of selected varieties of barley. The one bearing his name is now spread widely through Germany and has brought to its author many honours and prizes, amongst which are an honorary diploma from the Austrian Government (1905), a gold medal from the same Government (1906), a first prize in London (1906). His literary works were not numerous, but his publication " Züchtung botanisch reiner Formen böhmischer Gersten auf Grund der erblichen Eigenschaften " (*Berichte der Versuchsanstalt für Brauereiindustrie in Böhmen* 1902) has remained a standard work, being a complete account of his investigations on barley.

591. Dr. HENRY FAIRFIELD OSBORN, president of the " American Museum of Natural History " has been elected a foreign member of the " Royal Society " of London.

592. CARLO VANCOUVER PEPER, for 22 years professor of agriculture of the United States Department of Agriculture and ex-professor at the Washington State College died at Washington on 11 February last at the age of 58 years.

593. Prof. CHARLES R. RICHARDS, director of the " American Association of Museums ", has been decorated with the Legion of honour by the French Government.

594. Dr. GUSTAVO SCHELLENBERG, lecturer on botany at the University of Göttingen, received the DE CANDOLLE prize of the Physical and Natural History Society of Geneva.

505. The death has been announced of Prof. BRUNO SKALWEIT, teacher of Farm management (" Betrieblehre ") at the Agricultural Institute of the Albert University of Königsberg.

596. On 6th May 1926, at the age of 79 years, another eminent biological chemist died, FRANZ VON SOXHLET *Dr. phil., Dr. med. et Chir. h. c.* and ordinary professor of agricultural chemistry.

597. The Agricultural Society of Lombardy has also granted a gold medal to Ing. CARLO STABILINI in honour of his great activity during the last fifty years in promoting national agriculture and particularly that of Lombardy.

598. At Cluj, in Roumania, the death has occurred of prof. D. STEFANESCU, general director of horticulture at the Roumanian Ministry of Agriculture.

599. Dr. LOUIS, TIETJENS sworn expert of the Chamber of Commerce and Industry of Berlin and director of the Laboratory in Berlin of the German Potash Syndicate died on 19th January last at the age of 68 years.

600. Prof. ERNEST H. WILSON, assistant director of the " Arnold Arboretum ", has been presented with the gold medal coined in memory of VEITCH by the " British Royal Horticultural Society ". He is the first American who has received such an honour.

Dott. G. A. R. BORGHESANI, *direttore responsabile.*

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ORIGINAL ARTICLES

SERICULTURE IN PERSIA

Historical Sketch.

Persia has always been considered as one of the cradles of sericulture. It is thought that the rearing of silkworms was known there at the same time as in China.

The industry however had only slight importance up to the VIII century, a period when under the influence of the Arabs it began to be developed. At the end of the XIII century Geneva merchants bought silk from Ghilan. During the XV and XVI centuries, according to D. F. Lafont, numerous companies exchanging European goods, particularly sugar for silk and silk stuffs manufactured in Persia, installed themselves on the shores of the Caspian and of the Persian Gulf. Under the influence of this trade, sericulture developed rapidly and reached its zenith about 1669, with a production of 2 million kilogrammes of silk. Ghilan alone supplied almost half.

Towards the middle of the XVIII century, for reasons which have not been recorded, production decreased suddenly to such an extent that in 1750 scarcely more than 200 000 kgs. of silk were produced. That decrease was of short duration and in 1850 production went up again to a million kilogrammes, of which more than half was exported to Europe. Sericulture which was then, as these figures indicate, very flourishing, was hit by the terrible plague which ravaged Europe. Pebrine made its appearance in Persia about 1860. Production became almost nil, in 1885 it amounted to scarcely 40 000 kgs.

The drop in the price of silk in the European markets only accentuated the disaster. The breeding of silkworms was no longer successful. In many regions, especially in Khorassan, at Yezd and

Kachan, the plantations of mulberry trees were pulled up and replaced by opium poppy crops.

Pasteur's work having enabled the disease to be eradicated, sericulture was again encouraged in most silk producing countries.

This reaction however did not touch Persia, whose silkworm seed producing establishments were so ravaged by the disease that in 1867 she had to appeal to seed producers of Japan.

About 1890 some Greek seed producers introduced experimentally seed of the Baghdad breed. The results obtained being satisfactory, the importation of this seed increased rapidly in the Caspian provinces and began to revive on the Plateau. In 1906 close on 300 000 boxes were reared at Ghilan, 30 000 at Mazandaran and Khorassan and 4000 on the Plateau. Numerous firms installed suffocating and drying plant at Ghilan. There were in 1908 more than 70 of such installations, and during the same year about two and a half million kilogrammes of fresh cocoons were exported.

This period of prosperity was only to be of short duration ; the war occurred, the commerce of silks and cocoons was suspended. The Caspian provinces, especially Ghilan, were invaded, the sericultural establishments pillaged by the revolutionaries and bolchevist troops. The peasants, who could no longer sell their cocoons, again pulled up their mulberry trees and planted rice in their place, this being in demand for the provisioning of the armies and selling at a very remunerative price. After the war it was found more difficult to dispose of this product and silkworm rearing was again started. In 1924 about 40 000 boxes were reared in Ghilan ; in 1925, 90 000, and this year the market absorbed 100 000 boxes.

Present state of sericulture.

The restoration of sericulture is a slow process. The silk producing industry is hampered in its development :—

1) By the suppression of transit across Russia.

2) By the influence of exchange and the quality of the cocoons produced.

Before the war suffocated and dried cocoons in Persia were sent to Europe by the Caucasus. The low cost of transport enabled them to compete with cocoons from the far East..

The seed destined for the Persian rearing establishments also came through Batum and Baku.

As a result of the Russian revolution, transit was no longer permitted to foreign merchants, except in rare exceptional cases.

The despatch of cocoons being made in light but bulky bales, they could not be transported by caravans or by motor transport on account of the excessive cost which would be asked. Their export could only be effected economically through Russia, where transport is by boat and railway. The market is therefore to some extent monopolized by Russian companies. On the other hand, silkworm seed consigned to Persia is now sent by devious routes, coming either by Beyrout. Baghdad, Kermanshah, or by Trebizond-Tauris. The importers owing to the great risks they run (frost, premature hatching, etc.) sell them at a higher price. At the present time the Persian silk producer pays a great deal for the seed without knowing at what price he may be able to sell the produce.

Moreover, the high cost price of the cocoons owing to the superior value of Persian currency compared with the depreciated currency of importers (Italy, France) and their poor quality, causes them to be little in demand on the market, Japanese or Chinese raw silk is bought in preference.

The rearing of silkworms only gives the rearer a very small profit. That it is still practised is due to the cocoons being paid for in ready money and to the present scarcity of money in Ghilan. Many merchants of silkworm eggs even advance money to the silk producers to induce them to buy : the amount which varies from 5 kraus to one toman per box is then repaid at the time of production.

Conclusion.

Persia is preeminently a silk-producing country, the rearing of silkworms being practised in all Provinces except on the Persian littoral in consequence of very great heat and in a few regions unprovided with water or very cold. This industry can only be made prosperous by adoption of a thoroughly comprehensive silk producing policy.

In addition to expected improvements the silk producers must be educated, schools and experimental stations must be set up to seek the varieties of silkworms and mulberry trees best adapted to the different regions, for the distribution of mulberry plants, creation of nurseries for giving every encouragement to growers, and protecting them against sudden falls in selling prices. It should be ende-

avoured to make this production a household matter, that is to say that each person should rear a few boxes of silkworms eggs so as to increase his income and at the same time the national wealth, without however being too much affected in case of the always possible crisis.

L. R. DEBOUDEAU.
Director of the Persian Institute of Silk Seed. Teheran.

CLASSIFICATION OF CEREALS.

Can the American system of classification be applied in Europe?

In a paper published recently in this Review (1) it was stated, among other things, that the Roumanian Government was very deeply engaged with the question of the storage of cereals, examining the possibility of introducing the American system, with standardization, classification and certification. In that paper only the expediency of introducing into Roumania this well known and much boasted American system was dealt with, and it was then noted that this system, so far as constructive technic and machinery were concerned — silos and elevators — had begun to be general even in Europe in centres with a brisk trade in cereals, but that as regards commercial technic (standardization, classification and certification) it was not adopted in Europe.

We think that it might be interesting to study the question from this more general point of view and to investigate the causes which prevent the adoption in Europe of a system of commercial technic which has given such splendid results in America.

We propose to do so, but with this object we must begin by investigating the American system as a whole, without too much detail. The problem which we are dealing with is mainly one of storage, *i. e.* the concentration of stocks of cereals in the most important centres, classification and other operations which we shall examine later being only accessory operations, though also very important. In America, as everywhere, the original object was purely and simply that of a more convenient system of storage, capable of handling easily large quantities of cereals at the least possible cost; it was possible to effect this by means of improved mechanism, by automatic unloading and weighing, elevators, etc. on the one hand and the system

(1) Vol. III, October-December, 1925: "Situation of the Growth and Commerce of cereals in Roumania".

of silos with vertical cellular compartments on the other, a system allowing of a more rational utilization of the accommodation so provided and cheaper handling by automatic unloading of the cells.

This system of storing silos, elevators etc. has been introduced all over Europe and works admirably.

But in America the storage system was not considered complete here but was made to embrace also accessory systems of commercial technic, namely : — standardization, classification, certification, and warrantage, operations entirely independent of each other and especially independent of the actual system of storage.

To avoid any possible confusion we will first of all examine briefly each of these operations :—

(1) *Standardization* has for object the fixing each year of types of different quality categories for each kind, types represented by samples, termed " standards ", serving as basis for the classification of the respective cereals.

(2) *Classification* has for object the sorting of the cereals, by kinds, into quality categories, each subdivided into quality classes.

Classification, that is to say sorting into quality categories, follows the lines of the above mentioned standards, after which comes the subdivision of each quality category into classes.

There are therefore several quality categories for each kind of cereal (wheat, rye, maize, barley, and oats), according to the province of origin, the kind of crop (autumn or spring sown), the colour and other indications of this kind, as for example for wheats :— hard or soft. Then, for each quality category there are several classes formed on more or less recognized lines, such as the relative weight (relation between volume and absolute weight, generally expressed in kilogrammes per hectolitre), the percentage of foreign matter, and the conditioning, that is to say the keeping power of the goods.

(3) *Certification* consists in the fact that each consignor (the person who deposits the cereals) receives from the management which receives the deposit of cereals a certificate recording the making of this deposit, indicating the quantity, kind, quality category, class and other indications of an administrative kind.

There now comes in the essential point of the system : this certificate is not a document of the ownership of the goods deposited, but a document giving right to an equivalent quantity of similar goods of the same category and class.

This point is very important, for owing to it the goods deposited

are exempted from preserving their individuality, *i. e.* the management of the warehouse is not obliged to keep the goods separate for each owner, but mixes them according to category and class without troubling as to whom the different parts in each category and class belong; this is possible owing to the fact that the management is not obliged to deliver the actual goods deposited, whether on the spot or elsewhere, but only goods corresponding to the same category, class and conditioning.

It is chiefly in this, and we might almost say solely in this, that the great advantages of the American system lie, advantages which may be summed up as follows:—

1) Economy of space in the warehouse, for it is not obligatory to reserve cells of the warehouse for each owner even for the smallest quantity, or to wait until each owner has sufficient goods to fill the cell already engaged. By mixing the goods of several owners the cells are quickly filled and the charging of full rates for use of nearly empty compartments is thus avoided.

2) Facilities in transport, since it is not necessary to wait the arrival at destination of the goods consigned, but other equivalent goods, already available, can be delivered.

3) Facility of business dealings, since the risks of differences of guaranteed quality, quantities and of terms of transport, are undertaken by the management of the warehouse.

But to realize effectively the advantages enumerated in these three paragraphs, there are 3 *sine qua non* conditions without which the whole system become illusory or onerous:—

1) Very excellent transport facilities must be available so as to be able to meet every exigency without delay.

2) Very large quantities must be handled, with a very brisk turn-over, to ensure a return on the great amount of capital invested without being obliged to charge the consigners burdensome rates for storage.

3) A well chosen staff, exceptional both as regards professional capacity and especially as regards absolute trustworthiness is necessary.

It remains now to be seen:—

(*a*) Whether the countries of Europe are lacking in system of commercial technic in their European organizations, and whether the European cereal trade is really chaotic or not.

(*b*) Why European States have not yet adopted the American

system known as "*classification of cereals*", if it is really superior to the European systems.

* * *

Contrary to general opinion (except of course that of experts), cereal trade in Europe has an excellent organization of commercial technic, which though relatively old, has proved its superiority for European conditions and is still quite adequate to deal with any such, however pretentions, which have been formulated in Europe. We speak, of course, exclusively of the commercial technic side. Let us now see what this commercial technic in the European system is.

The principal object in all systems is that of enabling the two contracting parties, seller and buyer. to come to an agreement with the greatest possible precision, even at a distance, regarding the different qualities of cereals offered and regarding the conditioning of these cereals.

This is how Europeans long before Americans solved the problem :

There are for qualities :—

(1) "*Sealed samples*", authentic samples of the goods offered are delivered and it is guaranteed that the goods delivered will agree with the sealed sample. In English the clause is "*as per sample*".

This method is used especially for superior qualities, since it enables the full value of such goods to be realized.

In the American system, full valuation for a fine quality is impossible, for in making quality classes it is not possible to make an infinite number of divisions and it is also impossible to admit special mention for exceptionally fine qualities, as the goods no longer preserve their individuality ; on the contrary, each class, even the very best, only represents an average of qualities admitted in the respective class, of which there is in each class a higher and a lower limit for admissibility in that class, whence it results that the higher limit will always be sacrified in favour of the lower limit.

In the American system the object sought is not so much full valuation of the quality as that of the formation of large lots of goods of each class, so as to realize in this way the other advantages of the system ; *i. e.* something is sacrificed on the quality in order to gain advantages in handling, storage, transport, transfer, etc.

It is certainly a question of convenience, of calculation, but in order that this calculation should show that the American system is

right we should have to consider all the American conditions, conditions quite different from those of Europe.

In any case, one thing is certain, namely that the American system in no way pretends to wish, as is suggested by certain persons lacking knowledge in Europe, to raise the value of the qualities of cereals and thus contribute to the selection of qualities, such an aim on the contrary being achieved rather by the European systems.

(2) " *Types* ". — These are again samples of goods like the previous ones, but of a more general character than the latter, for in this case it is no longer a question of presenting an authentic sample taken from the goods offered, but only an informative sample, so to speak, which enables a more or les sprecise explanation of the qualities offered to be made at a distance.

This method, less rigid than the previous one and always subject to a margin of fluctuation fixed by custom, perfectly regulated and mentioned in the type contracts, has especially the advantage of informing the markets, both home and foreign, regarding the different qualities of cereals produced in the country in the respective year. These " *type samples* " have on the other hand a more or less fixed character, generally for dealing with one season's crop; goods are always so described by each selling firm and it is enough to mention this number in offers, correspondence or contracts.

(3) " *Special indications* ". — In this case the samples are replaced by a description of the category of quality, giving origin (province, region, district) colour, etc. and indicating the weight per hectolitre and the percentage of foreign matter all according to guarantee or taken as basis of the agreed price, compensating reciprocally for excess or deficit.

Generally this method is used in combination with the previous method, that is to say the *type samples* with *special indications*.

(4) " F A Q ". — Word composed of the initial letters of the three English words " *fair average quality* " but it is customary to add " generally recognized at the time and place of lading ", as the average quality may vary according to the region of origin and according to the time. This method, being in use in international commerce for the bulk of the cereals sold, is very interesting, as it is especially the qualities without special pretentions which form the bulk of imports and exports. But what is especially interesting in this method is the means of determining the " fair average quality at the place and time of lading " that is to say the control of this determination.

The control is done by means of "*standards*" that is to say type samples taken from the cargoes of different origins for each month; there "standards" are taken by agents of the corn exchanges and kept at the disposal of interested parties in case of need.

These "standards" are certainly the origin of the American classification; but, nevertheless, these two things should not be confounded, for the "standards" which we are now dealing with have only as object a basis of control in case of doubt or dispute, while the standards in the American system are type samples serving as basis of classification, that is to say for the distribution of the goods in groups of categories and quality classes. The standards with which we are here dealing exist not only for cereals but also for a number of other goods, especially for textiles, and it is only in this sense that the idea of standards generally spoken of in the commerce and industry of many articles should be taken.

* * *

As regards the conditioning of the goods, that is to say the keeping power or shall we say, the sanitary condition of the goods, the following three clauses are in use:—

(1) *Good merchandise sound and dry.* — Every cereal, to be considered as good, sound and dry, should on handling give the sensation of being cold and free from moisture; the slightest temperature which does not feel cold to the touch indicates the start of fermentation.

(2) *Such as it is,* is a clause which indicates that the buyer accepts the goods with the conditioning such as it is, that is to say that the buyer takes the risks of conditioning on himself. However custom, which is always conceived in a spirit of equity and has its basis on reciprocal loyalty, adds: — (the goods should be sound at the time of lading).

(3) "*Rye-terms*" or rye clause ("slight dry heat to be considered as good") means in usance that certain cereals heat during transit, but being sound and dry cool easily when they are placed in the open air. This is especially the case with rye, whence the expression "rye-terms", but it occurs also with maize, for which reason shipments of maize are almost exclusively dealt with under this express clause.

* * *

From what has been said we are easily convinced that :—

(1) There exists in Europe and elsewhere, as well as in America, a system enabling agreement to be reached with precision at a distance regarding the qualities of goods and their conditioning.

2) This system, which we may call the European system, is less rigid than the American system and it moreover permits the full value being given to superior qualities, so that it may therefore rather encourage the selection of cereals.

(3) In the American system quality is partly sacrificed to advantages gained by other sides of the system :— promptness in delivery, economy of space, facility of transfer.

In this manner we have answered the first of the two questions which were formulated above namely :—

(*a*) Whether the countries of Europe are lacking in system of commercial technic in their European organizations, and whether European cereal trade is really chaotic or not ?

The above notes offer an explicit answer thus :— The cereal trade in Europe is by no means chaotic ; it has a system of commercial technic which was formed and improved successively in accordance with European methods, means and exigencies.

As regards the second question formulated above :—

(*b*) Why European states have not yet adopted the American system known as " *classification of cereals* ", if it is really superior to the European systems.

Although the reply might be deduced from what has been explained above, we consider it useful all the same to insist more fully on this point to avoid all possible confusion. First of all it must be clearly noted that in the American system there are two perfectly distinct parts : — the contruction and mechanism part (silos and elevators) on the one hand and the commercial technic part (standards, classes and certificates) on the other.

The former is a question of storage, while the latter is simply a question of commercial technic.

The summary description of the American system given above shows that the first part, that of storage, can exist alone without the second part.

The converse does not hold good. The second part, that of commercial technic *American system* (classes and certificates) cannot exist and would have no reason for existence without the first part.

But that is not to say that another system of commercial technic cannot exist and function independently of the system of storage. Proof of this is furnished by what happens in Europe, where the commercial technic, very well organized up to the minutest detail, functions quite independently of the system of storage, very varied and often precisely identical with American storage silos and elevators.

In these conditions a question very naturally arises :— With the introduction of storage silos and elevators on the American system in large numbers into Europe, why was the European system of commercial technic persisted in ? Why was the second part of the American system obstinately rejected ?

The answer is very simple :— Because the conditions both of agriculture and commerce and the means of transport in Europe are entirely different from those in America.

Nor should it be thought that it is for lack of large quantities of cereals to be handled that countries in Europe are indifferent to the American system ; this might be true for certain European countries, but not for all.

The following table show that there are countries in Europe without classification, with a higher production of cereals than that of certain countries of America having the classification system ; such is the case of Germany and France compared with Canada, each of these two countries having a higher production than that of Canada. But what is still more characteristic is that France has a foreign commerce in cereals almost as large as that of Canada, while that of Germany is more than three times as large without having felt the necessity nor even the utility of introducing classification of cereals.

Great Britain, which has a relatively small production, has a foreign trade in cereals more than three times as great as that of the United States or of Canada. It must not be thought that a distinction is obligatory in this respect between importing and exporting countries for cereals ; the proof of this is furnished by the United States which, with their enormous production of over 1000 millions of quintals, only exported about 3 %, the classification of which is mainly for home trade. Canada only exported 20 % and Roumania exported 48 % of her production.

TABLE I. — *Average 1909-1913 in quintals.*

Countries	Grains	Production	Imports	Exports
Germany	Wheat	40 430 840	24 217 109	3 318 357
	Rye	101 318 075	3 893 220	7 940 578
	Barley	30 402 183	30 828 567	26 005
	Oats	86 186 182	5 569 857	4 156 356
	Maize	731 250	8 169 208	399
	Total	259 068 530	72 677 961	15 441 695
France	Wheat	88 626 740	10 388 937	47 603
	Rye	13 335 930	527 424	6 888
	Barley	11 501 594	1 376 643	173 017
	Oats	53 482 672	3 972 371	16 887
	Maize	5 661 834	4 745 954	25 315
	Total	172 618 740	21 011 329	269 710
Great Britain and Northern Ireland	Wheat	15 874 779	52 488 168	205 987
	Rye	—	411 367	1 692
	Barley	12 622 698	10 866 439	21 948
	Oats	23 551 816	9 151 179	171 275
	Maize	—	21 135 503	344 698
	Total	52 049 293	94 052 656	745 620
Roumania	Wheat	23 893 233	48 185	13 362 640
	Rye	1 188 441	9 536	903 477
	Barley	5 440 528	16 991	3 525 335
	Oats	4 216 174	7 623	1 566 887
	Maize	27 302 810	60 242	9 867 281
	Total	62 041 180	142 577	29 255 620
Canada	Wheat	53 647 786	55 363	20 207 138
	Rye	531 980	7 878	26 729
	Barley	9 857 335	18 306	1 047 228
	Oats	54 237 610	12 941	1 816 277
	Maize	4 393 719	2 055 059	4 349
	Total	122 668 430	2 749 547	23 101 721
United States	Wheat	187 819 793	255 876	14 510 438
	Rye	9 168 085	—	145 345
	Barley	40 237 182	—	1 627 879
	Oats	165 965 468	632 820	1 189 603
	Maize	688 967 478	751 714	11 010 736
	Total	1 092 158 006	1 640 410	28 484 001

But the most characteristic example is furnished by Germany which has a very high production (260 millions of quintals) and at the same time a very appreciable foreign commerce in cereals, both as imports (72 600 000 quintals) and as exports (15 500 000 quintals) while Canada exported 23 000 000 quintals and the United States 28 500 000 quintals in round numbers (1).

Germany has then a very large home trade in cereals, in short she contains, more than any other country in the world, all those elements which might seem to justify the introduction of the system of classification of cereals, and yet she has abstained from doing so. What makes it all the more interesting for our thesis is that Germany is not a country which has neglected the problem of storage of cereals, on the contrary she has made further progress in the matter than any other country in Europe.

Germany has encouraged associations for storage of cereals in every way, and it is owing to such encouragement that there are at the present time in Germany a very large number of warehouses for storing cereals, for the greater part on the silo system and all having quite modern elevators, cleaning apparatus, etc.

Despite all this apparatus and plant and despite even its organizations, which make it easy for cereal producers to have sales in common, Germany, which has all that could be desired in this respect, has resisted the temptation to introduce into her country the commercial technic of the American system represented by the classification of cereals.

If such is the situation for Germany, all the more reason for other countries, finding themselves situated in less favourable conditions for an American system, to abstain from that system in spite of the magnificent results which it has given in America.

This once more proves that what is excellent in America is not always practical in Europe, seeing that circumstances and means are quite different.

E. M. Brancovici,

Professor at the Academy of Commercial and Industrial Research of Bucharest.

(1) As is seen in the statistical tables given above (taken all from the *Yearbook of Agricultural Statistics* of the International Institute of Agriculture of Rome) we have taken the averages of five pre-war years, since the post-war situations are everywhere more or less abnormal.

SCIENTIFIC MANAGEMENT OF AGRICULTURAL LABOUR, ITS DEVELOPMENT IN GERMANY AND ITS INTERNATIONAL IMPORTANCE.

The last century was one of enormous progress in German agriculture, a fact too well known to need further demonstration here. Equal progress was made in other countries. No doubt one of the causes was the development in agricultural science. The father of agricultural science in Germany, Albrecht THAER, pointed out that agriculture can be regarded either as merely physical work, or as an art or as a science. But even to-day agriculture still lacks scientific application, and agricultural science itself still requires considerable development. This development however depends itself among other things on the state of agriculture at the time, the general economic position, and the degree of development of science in general and of natural science in particular. Many of the great advances in chemistry, in physics, in zoology, in botany, in the science of heredity, organization and other spheres have found expression in important developments in agriculture. In this place we shall only mention, from among scores of others, two names whose scientific work has benefited the whole world, Justus LIEBIG and Gregor MENDEL.

The attention paid to the different branches of agricultural science at different times has been very different. So long as it was merely a question of increasing the yields, the conditions being such that increased gross yield meant increased net yield, the branches of agricultural science which received the greatest attention were the natural sciences e. g. plant-structure, cattle-breeding, etc. In time of bad prices more attention had to be paid to the economic side of agriculture and aid was sought in economics.

The consideration given by agricultural science to the problem of agricultural labour was also very different at different times. Thus THAER in his standard text-book "Grundsätze der rationellen Landwirtschaft", when considering the general question of agricultural labour, deals very fully with the problem of the skilled labourer. Similarly

Johann Heinrich von THÜNEN, treats in his "Isolierte Staat" very fully of the problem of labour and wages. Later this side of the problem was again neglected and plant-structure and cattle breeding again came to the front. It was not till the eighties that two authorities on agricultural management von der GOLTZ and POHL laid stress on the human factor again. The latter also made the first and a very successful attempt indeed at a practical and scientific analysis of human labour. Again recently it was AEREBOE who, as in other works too, in his "Landwirtschaftliche Betriebslehre", emphasized the importance of the human labour problem in agriculture and made useful suggestions. He suggests that nine-tenths of the problem of agriculture consists in the management in human material.

Before the war in Germany much attention used to be paid to the problem of agricultural work by the management section of the German Agricultural Society, and the chief of that section, Oekonomierat Dr. STIEGER never lost an opportunity of impressing on hearers its importance, when speaking at any one of the many travelling exhibitions. It was also he who first made an attempt to form this problem of agricultural labour into a separate and distinct section of agricultural science, and his ideas on this subject can be found in his book "Der Mensch in der Landwirtschaft" published in 1922.

All this very promising work in Germany suffered a setback during the war. In 1919 the author of this paper gave the lead in starting experimental work on the agricultural labour question, making use both of the work of Frederic W. TAYLOR and of the psychotechnical methods employed for years in industry. But for this type of work both an experimental farm and a scientific institute were necessary. This need was soon supplied by the Government of the Free State of Saxony, who not only offered but also equipped the Pommritz estate and thus made possible the work of Prof. DERLITZKI, whose name soon became famous in Germany and abroad. The aim of the author at that time was to improve all kinds of agricultural work by exhaustive scientific studies, and then, making use of the results thus obtained, to educate and train the agricultural worker accordingly. This work did not remain confined to Pommritz, for soon it was also begun at Landsberg a. Warthe, Königsberg i. Pr., Stettin and by many practical farmers who got interested in it. A small journal also began to be published, as can be seen from the bibliography at the end of this paper. Scientific employment of agricultural labour began to be included in the curriculum of many colleges, and there is no

doubt, that its neglect for so many years will be more than compensated by a very rapid development in the next few years, for which the action of the colleges will be largely responsible. Agriculturists were at first sceptical, but are now convinced apparently of its soundness and are readily applying its principles. In a few years time some of the results and ideas of its science will be shewn to be for the common good of agriculture. The importance of its study is enhanced very considerably by the knowledge that its results may enable us ultimately to reduce very considerably the wages bill, the largest item in general working expenses, of which it seldom forms less than 30 % and often more than 50 %.

As in other branches of agricultural or other sciences further development depends on international effort, which implies a certain give and take between nations, and I have no doubt that the German scientist will worthily fulfil his part. I shall now attempt to give a brief account of what appears to me to be the specific German, and the general international problem. Though we shall concern ourselves mainly with physical work, we must not forget that there is hardly any work which requires greater mental effort, and that in any case physical and mental effort is closely related.

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Competent work can only be done by the competent. Hence the first and last problem and the very basis of the matter consists in the creation and preservation of a suitably competent and skilled rural population. But in Germany, as in other industrial countries, a process very alarming for agriculture has been taking place in the last decades. The quantity and quality of its rural population has been constantly diminishing, thus, while in 1882 the land and forest workers in Germany numbered 3,975,204, in 1907 they were only 3,388,892 strong, including 387,329 aliens, showing a decrease in rural population of very nearly a million, which must be considered as a very serious loss to agriculture especially when thinking of future sources of labour. According to HAINISCH's " Die Landflucht " the same has been observed also in other countries.

The rural population must be physically, mentally and morally fit, and hence it appears to me that racial hygiene will have to be our first auxiliary science. That undesirable leakage of emigration must be absolutely stopped, and its opposite must be aimed at. No doubt

it would be an excellent thing if we could apply to man the ideas applied and tested in the case of animal breeding; in fact the marriage laws of the different countries are modest attempts in this direction. Propaganda might achieve much.

For the proper judgement of the human body and its abilities we must get a fuller knowledge of its anatomy and its mechanics.

It has to be taken into account that the upbringing and rearing of the young in country districts is not such as to result ultimately in a healthy and strong man, even granted the best hereditary predispositions. Thus infantile mortality in the country is much higher than in the towns. But proper rearing is not only of importance for the proper building-up of the body but in the last instance, it also determines that body's ability for work. If only for that reason alone our problem will have to concern itself with nutrition and there can be no doubt whatsoever that its study, particularly in times of highest mortality, in the different countries and localities will lead to important conclusions. Just as we cannot judge properly the human body without an adequate knowledge of anatomy, so, in the study of the problem of nutrition we shall have to make use of physiology and of the physiology of nutrition in particular. Undoubtedly it is just as important for man as it has rightly been considered to be for animals.

But skill as well as physical strength is essential to the agricultural labourer especially with the advance in quantity and quality of machinery used. That skill must be gained by appropriate bodily exercises, and the introduction of the spirit of sport into agriculture will help much in increasing the pleasure of work.

The prevalent view, not confined to Germany, has been that even the feeble-minded are suitable for agricultural work. And as HAINISCH tells in one of his books, in some districts of France the healthiest and cleverest children emigrated to town, while the weak, physically and mentally, stayed in the country and were absorbed into agriculture. Yet as a matter of fact there is hardly a profession which calls for so many abilities, so much knowledge and understanding as agriculture. The intelligent worker will always find scope for his intelligence in agriculture. Unfortunately, however, the rural population is provided with schools and other educational facilities on a much poorer scale than the urban population, and very much more still remains to be done in Germany for the land worker by improvement in educational facilities.

Any, even the simplest, agricultural work is performed not only with the body but also with the heart and soul. Where there is no love for the work, there can be no pleasure derived from it, and no proper will to work can exist. The will to work is the motive power, the steam, without which even the most perfect engine cannot function. Much will also have to be done in this direction to improve the human material. Though education, which must start early, can help much, yet its powers are somewhat limited, since it can never completely eradicate a hereditary inclination to laziness. And so psychology appears of paramount importance, and on experimental psychology we shall touch later.

The size of the farm has a considerable influence on man and his work. Where the farm is small, a man is closely bound up with it and the soil, and where the labour is provided by the family the interests of all are the same. But, as the size increases more and more, outside labour has to be employed, lacking any natural interest in the farm. That interest must therefore be artificially created and maintained. With increasing size it becomes increasingly possible to use machinery, and to employ special workers for special work, and to introduce a division of labour. The small sized farm is handicapped in all these respects, and no amount of co-operation will overcome this handicap. However, it is not true that this particular science can be only or mainly of advantage to the large sized farm, though its benefit to a smaller farm may take another form. This is of the greatest importance to Germany, where three-fourths of the total cultivated land is in the hands of the small or medium sized farmer.

It is just the ordinary manual work which has so far received too little attention, and I do not doubt that much of it could be improved with a resulting increased productivity. If manual work is of the greatest importance on the small farm, its importance is not much diminished, despite introduction of machinery, also on the big farm. These considerations will hold good in other countries. True the intensity of working will make a difference, e. g. the big American wheat farm can use a greater proportion of machinery. And the more one passes in the direction of crops needing intensive cultivation e. g. potatoes, turnips etc., the greater becomes the need for employing manual labour. It would be very desirable to get, by means of international comparisons, information as to requirements of labour at farms of different sizes and under different systems of management. To make such figures comparative the work would have to be carried

out under the direction of some central authority, and a lead in this respect from the International Institute of Agriculture would be welcome. (*)

No doubt the most important branch of agricultural science still remains the performance of agricultural work, i. e. the relation between man and the object of his work, whether through the intermediary of tools or machinery, or not. Agricultural work, even in Germany alone, and no doubt much more so in other countries, is very varied. This can be partly accounted for by different climatic and soil conditions, by the different systems of management, by the different types of work to be done and no doubt by the human element and the different level of civilisation attained at any given time. In many cases however, in fact generally, the above explanation does not appear satisfactory or sufficient, when one considers the simple hand-tools, hoes, shovels, scythes, forks etc. which are used in the most diverse forms for the same work in different places, or again the plough share. General geographical investigations however on some of these tools, e. g. rakes and spades, carried out in Germany lead to the conclusion that, it is not as would appear, an adjustment of the tool to the conditions of work, with which we are here dealing, but that use is here rather a question of tribal peculiarity. More exact and local investigations showed that often in a very limited space e. g. two neighbouring villages we find the greatest diversity in tools employed for the same purpose.

These deviations and peculiarities become even more striking when one considers the process of working itself. Although mechanisation of industry by the introduction of elaborate machinery or other similar arrangements may lead to success in some cases, still we must not neglect the simple hand-tool. And let it be said here to the credit of the industrial investigator that he does not forget it. Undoubtedly among the great variety of different tools in use, there are some peculiarly suitable for a given type of soil or for a given kind of fruit and this can always be found out by comparative working experiment's and by general observations. Investigations on these lines, has been begun in Germany but on account of its difficulties it will take some time.

This problem will have to be dealt with internationally. It would be instructive to make an inventory of the different tools used

* This has now actually been undertaken by the institute. *Ed.*

in the different countries, and to form somewhere a permanent collection of illustrations and descriptions. Who could give a better lead in this work also than the International Institute of Agriculture? Later on perhaps a collection of the different tools themselves could be formed. If a start were made in a number of different countries there would be greater hope of ultimate realisation of our aim. I should also like to draw attention to the great difference in the materials used for making these tools as well as to the differences in weight between them. Too heavy or too light tools tend to inefficiency.

Machines and bigger tools differ also in this respect from the small hand tools, that they are very often produced on a large scale in works, and thus may become products of international trade. But their importance does not lie even in this or in that they perform the work for which they were originally designed, but, in the fact that they do the work with very little human effort.

Now how are we to determine the different degrees of usefulness of the different tools? Only by careful study of their mode of working. In this we shall have to make use of previous psychological work, in its application to industry, and mainly that referring to time, movement and fatigue. This work can be carried out in one of two ways. Either, with the aid of the simplest tools in practice, or with the aid of the most up-to-date scientific apparatus in specially equipped laboratories. In practice, however, we shall confine ourselves, in most cases, to the elimination of the inappropriate e. g. the elimination of wrong movements etc. Investigations carried out so far in Germany prove, that just as tools can differ very considerably over a very limited area, so can the modes of doing different tasks e. g. the binding of wheat, planting of potatoes, etc. These differences, which, can only be explained by habit and origin, find expression also in practice, namely, in differences of work done. Only lack of space prevents me from quoting many examples, and no doubt many will occur to any practical farmer.

Investigations of the different agricultural tools and of the different modes of doing tasks shows how much more has still to be done for the perfection of the different, separate, agricultural tasks. But we must again proceed from analysis to synthesis, and, considering the totality of the agricultural tools, investigate first the different separate processes of working, and then compare them with each other. Thus it is possible to cut corn with a sickle but also with various types of scythes or mowing-machines. Binding and carting again can be

performed in different ways. The planting of potatoes too shows considerable differences, whether it be in the mode of preparing the field, or in differences of tilling implements used or lastly in the different ways of planting, by machine or by hand. The same differences are seen in every kind of agricultural work and probably apply in every country. These different modes of working are also a very important field for our investigations, which will have to be carried out with the aid of the above mentioned auxiliary sciences.

Besides very careful time observations the cinema will be a great help in this work, for, on the one hand it will enable us to gain a deeper insight into the different agricultural processes, and on the other it will be a very important educational aid, illustrating the correct methods of procedure in the different types of agricultural work. I would suggest, therefore, that the International Institute of Agriculture should form a collection of suitable films and photos, and by reciprocal exchange and lending make them available to workers in this field. In addition there would have to be available the results of working studies with a description of all the circumstances in which they were carried out. These external circumstances or so-called geopsychical phenomena are of the utmost importance.

The mode of farm operation employed is closely related to the size of the farm. To choose a very simple example. As the size of the farm increases the tillage which was originally done by hand begins to be carried out by oxen, the next size demands horse labour, till in the end we get to motor or steam power. Every kind of work will have to be reviewed separately, and, by taking into account all the existing circumstances, we should by suitable comparative experiments be able to achieve further progress.

The amount of work to be done is largely determined by the form of the farm, and the form depends to a large extent on the habits of living of the people. Where every one lives separately on his own farm some distance away from others, the farm is usually an uninterrupted whole with large easily worked divisions. Where, however men prefer to live in small or large or very large villages, the position and the form of the fields becomes and more unfavourable. The roads to the furthest fields are frequently very long, and the fields are often so small as to be incapable of being tilled otherwise than by hand. Such lands, because of their separation from the worker's dwelling, and the unnecessarily long distance to be traversed, cause a great waste of energy and therefore a poor return for the work and time spent.

But means of communications, roads etc. must not be forgotten as determining ultimately the pace of men, and the performance of the draught animal and scope of motor traction. On this question too exhaustive and exact numerical information from the different countries would be very useful.

The influence of the shape of the piece of land on the work has already been noticed but it has only recently been the subject of careful investigation in Germany. It has been found, as was expected, that in the case of animal traction work e. g. ploughing, the efficiency of the work rose with increasing distance of working but not indefinitely, for on distances greater than 600 metres the number of rest stops is much greater, a fact which decreased the efficiency. For hoeing work short distances give the best results, but optimum results much depend on the general working conditions.

The steading always necessitates a great deal of work. A consideration of steadings in the different parts of only one country, like Germany, demonstrates a great diversity of method employed. The explanation of this will be found both in the different size of the farms and in the different general conditions, but, even more perhaps in the peculiar and characteristic building and living habits of the rural population of the given district. It would appear an obvious necessity for the internal arrangements and the distributions of the different buildings round the steading to be such as to help in the performance of the necessary work with the least expenditure of labour. But this is very seldom found to be the case. In the majority of cases no notice is taken of this permanent avoidable waste of effort. A very important labour saving service would be the introduction of suitable mechanical implements into the barn, shed and outhouse. This question of proper arrangement and equipment of the yard and farm buildings has of late received much serious attention in Germany, to mention only the suggestions of ENDRES in his book " Der Gutshof von 1925 ". Once all concerned have realized that proper yard arrangement and building equipment must be also adapted to the general existing conditions, there can be no doubt that agriculture will profit greatly. True these or similar ideas have already found expression, although, from a different point of view, in agricultural architecture, but there the question of labour has not received its due share of consideration. Faulty yard and building arrangements, but more still unfavourable position of the fields, as pointed out before, account to a large extent for the excessive labour and time used per unit surface on the small

farm as compared with the large one. In 1907 in Germany the time and labour used by a 0.5-2.0 hectare farm as compared with a 100 hectare farm was seven times as much, while on a 2-4 hectare farm it was four times as much. The amount of agricultural labour permanently employed per 100 hectares of cultivated land was for the above three different sized farms respectively 94, 12 and 63.

With the question of work on the farm is bound up that of house work, for in agriculture the woman's work is of the greatest possible importance. For this reason the house-work should be made as easy as possible, and this could be best achieved by the introduction of suitable labour-saving appliances. However, hitherto the general arrangement of the rooms and the type of the domestic utensils in general use have not conformed to the requirements of modern domestic science. But in view of the great interest which women in all countries display in these questions, undoubtedly here too much could be accomplished by international effort.

But these questions belong more to the science of agricultural management, and with them we are not prepared to deal in greater detail here — such questions as:— how a farmer can best ensure a uniform labour supply all the year round, etc.

Much depends in agriculture on the proper use made of the available labour. Even the preparation of the work, first the general and then the special idea, determines considerably its ultimate failure or success. Here agriculture can learn from industry. It has been often pointed out that agriculture is badly handicapped by the fact that a sudden change in the weather may completely disarrange the day's plans. If so, it is one more point in favour of my contention that the day's plans should always be made with every possibility in view, so that at the shortest notice it should be possible to redispose the available labour and this with the least waste of time. In most cases it is the faulty and the badly thought out disposition of the labour which is the cause of the greatest waste of time, and lessens both the work done and wages earned. One of the things which will help very considerably in a proper work organisation is efficient book-keeping, and to the problem of devising a suitable system of book-keeping for agriculture we shall have to apply ourselves. Some very promising attempts in this direction are already in existence.

If we have been dealing so far with the external conditions of work, we must now return again, to the consideration of the human

element. We have been investigating so far how we can increase the worker's knowledge of his work, also pointing out that the proper will to work is perhaps of not less, possibly of greater importance. We are justified in saying that part of the German rural population which works on it own property has an enormous will to work, while the property-less part of the population i. e. the one which sells its labour, though having a will to work, has got it for evident reasons in a somewhat smaller degree. The question therefore arises. How can the will to work, and through it, the efficiency of its labour, be increased in this part of the rural population too? In answering this we shall have to consider the farms of different sizes separately. Where the work is done mostly by hired labour, as on the large farm, the interest in the work will have to be raised and maintained by economic means i. e. by the use of a suitable wages system on a sliding scale. The piece work system of wages, especially in the form of the *Pensum prämienlohnes* (work bonus) system is being used to an increasing extent in German agriculture, and is no doubt very suitable as an incentive to a greater effort. However, it is a very delicate idea, which will only yield desirable results in expert hands. Because of the constantly changing conditions it is almost impossible to lay down in agriculture any basic numerical relations between effort (work) and remuneration. Only properly conducted labour studies with a proper knowledge of all the circumstances in which they have been carried out can lead to success. But the success thus achieved is sometimes surprising. Cases are known in which simple transition from day wages to the work Bonus system led to a 100 % increase in efficiency of the work, and this, not through some momentary overstraining, but because of the better use made of his powers by the worker. The increased wage, for it is only right that the worker should expect and get an increased wage for an increased effort, is the best means of retaining the agricultural worker at his profession and on the land.

What is true of the worker is not less true of the farmer, although for quite different reasons. For, though not interested in wages as such, or in the systems of wage payments, yet he is intensely interested in the results of the work, since higher results mean for him higher remuneration, if one can use this term.

The success of the work depends sometimes also on the method of its performance. Thus it has been found in many cases, by ob-

servation and experiments, that working in columns, as is still the way of working in many operations, reduces the efficiency very considerably. And this because the least efficient among the workers determines the pace of working. Hence the general conclusion, that a number of equally skilled people is more efficient than a great number of differently skilled.

The best results are got when every one is performing the work for which he is best suited. The attempts to place people in occupations for which they are best suited, or keep them out of occupations in which they are least useful, has led to the introduction of vocational tests in the case of many of the town industries. This is easy in their case, because industry leads to a great number of uniform activities, which make possible the devising of suitable standards for vocational tests. The matter is quite different in the case of agriculture. The great variety of agricultural implements makes it very difficult indeed to devise suitable tests for given operations, and because of this difficulty vocational tests have so far received very little attention in agriculture. This difficulty is quite evident in the case of the small farm, but things are somewhat different on the large farm. Here in view of the employment of a certain amount of specialised labour e. g. at the machines, in the cattle-sheds etc., the devising of suitable vocational tests should not be so very difficult. Although no doubt the question of work will for some years to come be in the forefront of the problems occupying the scientific employment of agricultural labour, still it would be an excellent thing by international co-operation to develop and devise now appropriate vocational tests.

A further great problem will be the education for work. This must be begun early and appropriately carried out. Agriculture is in this respect in a much happier position than other professions. Attempts are being made in Germany, to provide every agricultural worker with a systematic professional education. If successful this will demand a quick provision of a large number of educational and experimental farm institutes.

For many years attempts have been made to create a greater sense of well -being among the rural population by enriching and raising the spiritual life of the country side, for only thus can we create that pleasure in work, without which no true will to work can ever exist. In Germany much has been done in this direction by the German Society for rural welfare under the leadership of

SOHNREY. A satisfied and an industrious rural population, which not only supplies the town with food and work, but also constantly with fresh blood, fresh energy and vigorous health, is the principal source of national vitality of every State.

Prof. Dr. W. SEEDORF,
Göttingen.

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THE SCIENTIFIC INSTITUTE OF AGRICULTURAL TECHNOLOGY AT KIEFF.

In 1924 the Ukraine (U.S.S.R.) was enriched by the foundation of a new scientific Institute of Agricultural Technology in connection with the Polytechnic Institute at Kieff.

The idea of founding such a scientific institute in the Ukraine and at Kieff is not very new.

About 20 years ago a number of people who viewed with favour the progress made by the Kieff section of the Russian Technical Society determined to found here an Institute which should be able to give answers based on actual experiments to the many theoretical and practical questions arising in agricultural Chemistry and technology. They considered that such an institute should be able to do experiments under conditions similar to those obtaining in practice, and should serve as the centre of a group dealing with that particular branch of work for the whole district.

To satisfy these conditions the Institute must be able to count on the collaboration of a number of well equipped scientific institutes and above all on an experimental Station fitted with apparatus similar though smaller to those used in the great factories. Although this was a good idea whose realization would most certainly have played an important part in the development and progress of the sugar industry in Russia, it was not carried into effect until the revolution owing to the technical Society's lack of funds for carrying out the entire plan. Strange as it may seem, the Society of sugar growers, who, one would imagine, should have been keenly interested in the execution of the scheme and have felt it a duty to help the technical Society with the necessary funds, did not welcome it, and the idea was dropped. After the Russian revolution in the month of October the administration of agriculture became centralised in the hands of the respective central organisations of the new government, and I then raised again the question of setting up this Institute of Agricultural Science.

PLATE XXIX

Fig. 103. — General view of the experimental Station of the Scientific Institute of Agricultural Technology at Kieff. (South Side).

Fig. 104. — Same (North side).

PLATE XXX

FIG. 105. — General view of the Chemical laboratory.

FIG. 106. — General view of the library and reading room.

PLATE XXXI

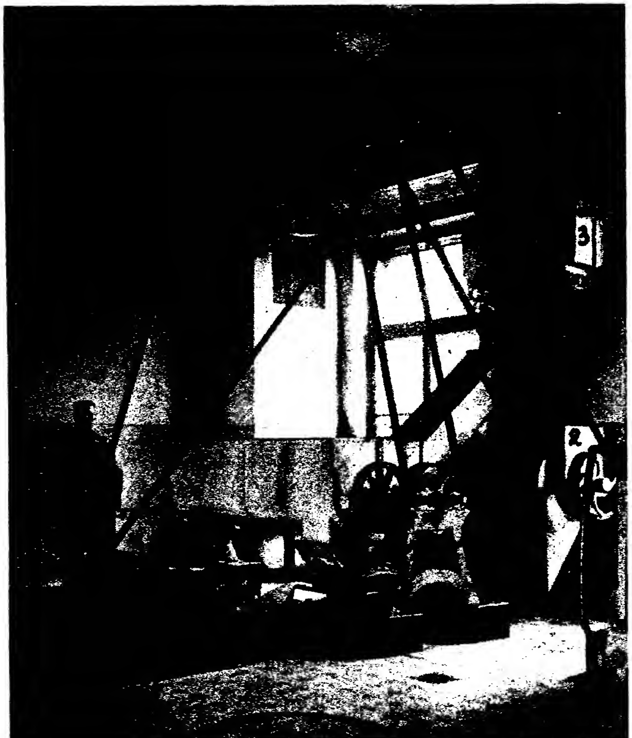

FIG. 107. — Experimental Station: 1) Washing apparatus — 2) Sugar Beet Slices — 3) Collector — 4) Motor.

FIG. 108. — Experimental Station: 5) Diffusion battery continuous system Eng. E. KRAJENSKY — 6) Motor for forcing back the juice.

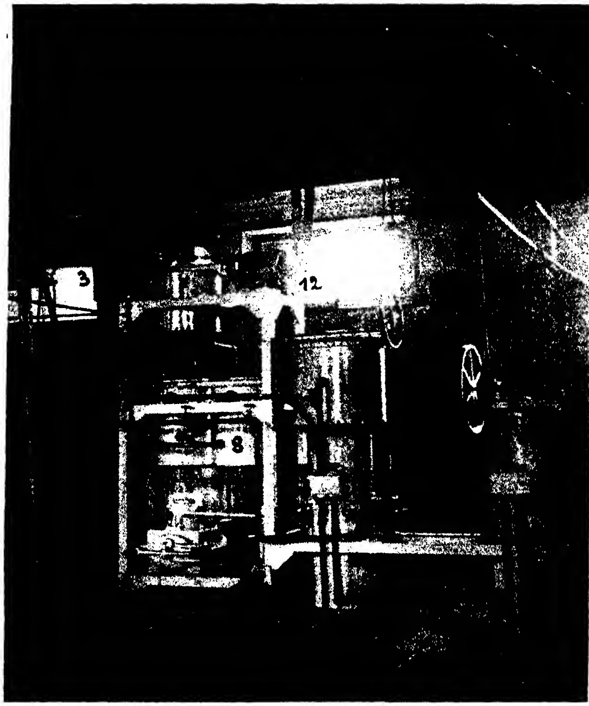

FIG. 109. — Experimental Station: 7) Milk of lime stirrer — 8) Two purifiers — 9) Continued action saturator, R. EHRHARD's system — 10) Continued action saturator POTAPOW's system — 11) Sulphur furnace — 12) Motor — 13) Automatic draining machine.

FIG. 110. — Experimental Station: 14) Evaporation battery quadruple effect Robert System I, II, III, IV, — Cylinder bodies.

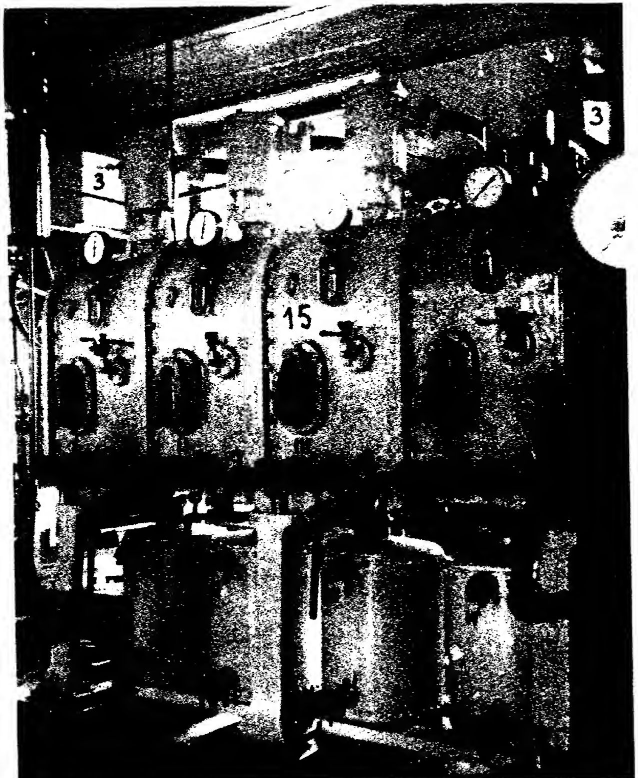

FIG. 111. — Experimental Station: 15) Evaporation battery quadruple effect, Eng. VITROVITCH system I, II, III, IV. Cylinder bodies each with automatic draining apparatus

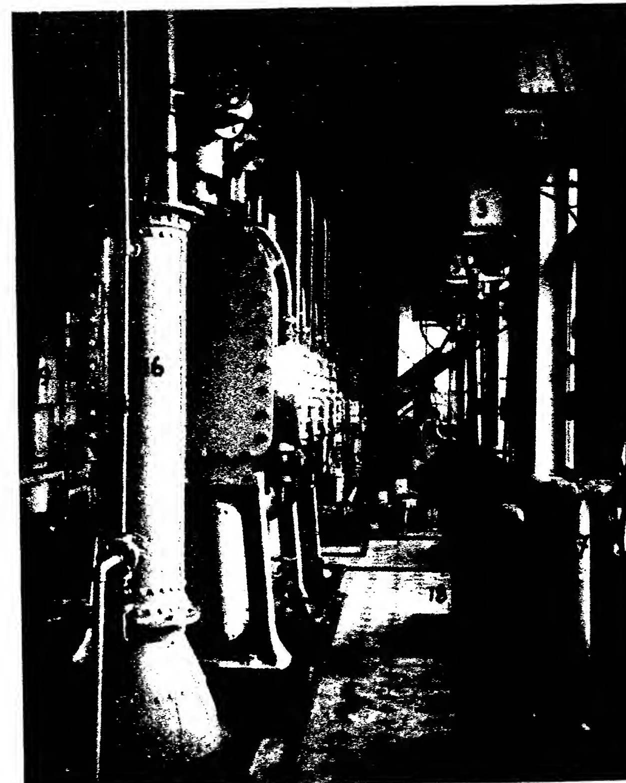

FIG. 112. — Experimental Station: 16) Dry Surface Condenser — 17) Pneumatic pump — 18) Motor for the pump.

PLATE XXXIV

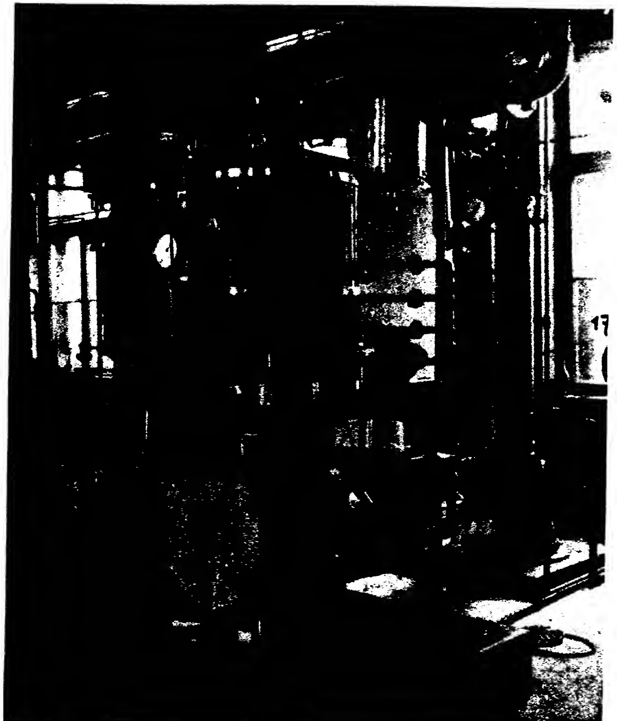

FIG. 113. — Experimental Station: 19) Vacuum pump for the sirup of the 1st Cristallisation — 25) Sirup stirrer.

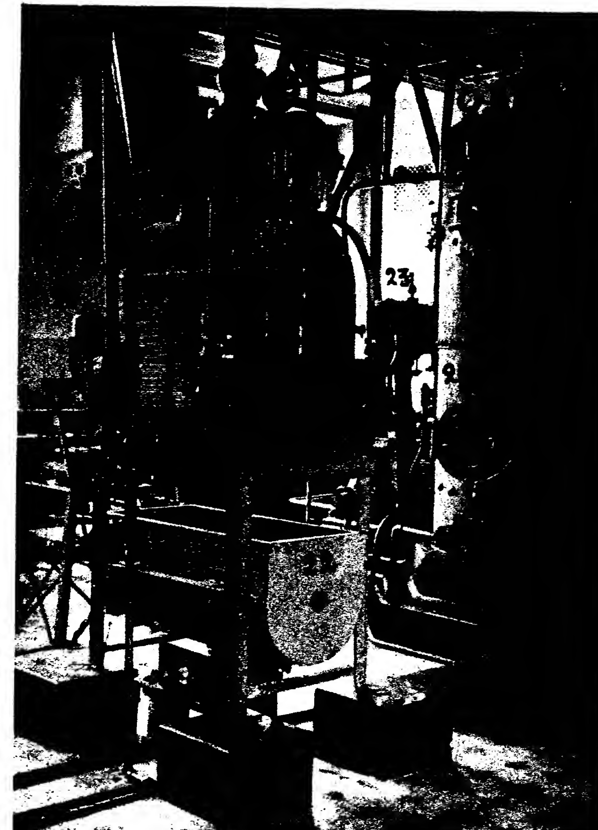

FIG. 114. — Experimental Station: 21) Vacuum pump for sirup of the 2nd cristallisation LEX GEROLD system — 22) Sirup stirrer — 23) Steam [illegible]

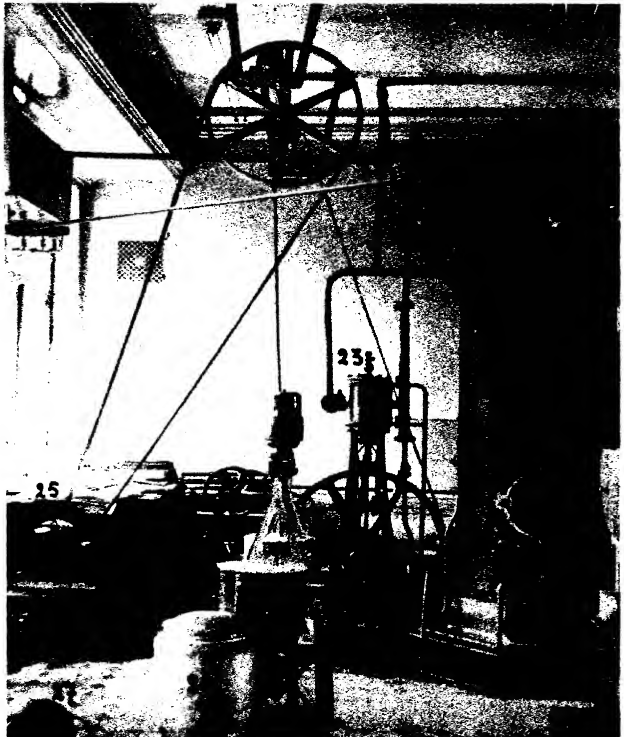

FIG. 115. — Experimental Station: 25. 8 Kilowatt motor - - 26) 3 Centrifuges - - 27) Motor.

FIG. 116. - - Experimental Station 28) Steam boiler at pressure of 6 atmospheres - 29) Vacuum pump for refining - - 30) Receptable Pasburg system.

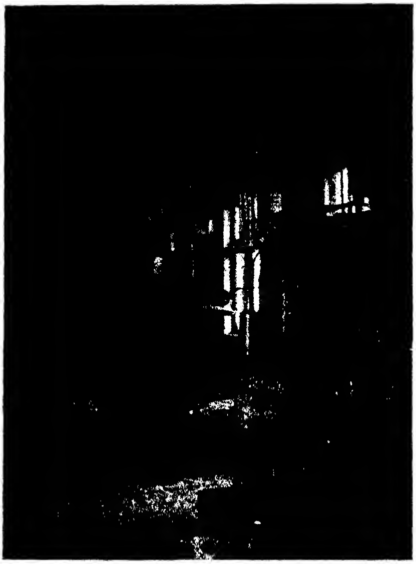

FIG. 117 — Experimental Station: 31) Wort rectifying column — 32) Refrigerator — 33) 2 Fermentation Vats — 34) Rectifying Column BARBET.

FIG. 118. — Experimental Station: 35) Vacuum pump for boiling potato wort — 36. Condenser.

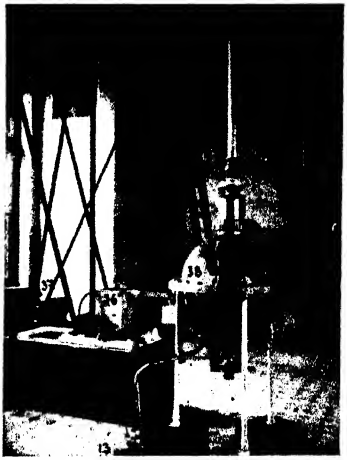

FIG. 119. — Experimental Station: 37) Potato rasp — 38) Motor 39. Vacuum pump.

Despite the very bad economic situation in the country, the idea was sympathetically received and it was decided to start the work necessary for its materialisation.

Towards the end of 1919 designs were drawn up for the equipment primarily of an experimental Station for the sugar industry. The making of the apparatus was entrusted to the work shops of the sugar factories. The end of 1920 saw the completion of the greater part of the equipment, and consequently the opening of the experimental Station for the sugar industry took place at Koursk early in 1921.

At a joint conference of the Union of sugar workers and of the Directors of the Sugar Industry held at Kieff in November 1921 it was decided on my advice to found an experimental station at Kieff, which should be the central station in all Russia for the sugar industry. Thereupon the whole of Koursk station equipment was sent back to Kieff to be under the agricultural Technology department of the Polytechnic Institute there and a certain amount of extra equipment was ordered. The Polytechnic Institute allotted enough room in its chemical laboratory for the provisional installation of this equipment, until such time as a special building should have been put up for the station.

Now the Agricultural Technology department of the Polytechnic Institute of Kieff already possessed the equipment of an experimental Station for industrial fermentation products, and hence it was decided to extend slightly the original project for the organisation of a research station dealing only with the sugar industry and to create instead a scientific research institute for dealing with the technology of every agricultural industry, which should cover all scientific experimental research on the sugar industry, the production of alcohol, beer, starch, molasses, vinegar, etc.

The equipment of this research institute is now complete and some idea of its arrangements can be got from looking at the reproductions given here of 17 photographs.

Among the machines will be seen wonderfully made models of those used in the factories, of which some are of recent invention and have been first tried at the experimental station. The Station is run exclusively by electricity and uses a special generating installation. It is furnished with very excellent measuring apparatus which allow of a minute control of operations and of the utilisation of energy.

The creation of the scientific Institute of Agricultural Technology is of enormous importance to the Ukraine and to the whole of the U.S.S.R. Firstly this Institute will allow the study under conditions similar to those found in practice of many questions theoretical and practical of agricultural Chemistry and other branches, which have not hitherto been studied and whose study in actual practice was often impossible for technical and economic reasons.

Again the Institute will act as the centre of study for trying out new type industrial machinery and new processes of production before their trial on a larger scale in actual practice.

Finally it will serve as the focus of all the living forces of the country, which are devoted to the perfecting of agricultural technology, by the concentration of all the scientific work and thought on this subject and by bringing the results of this work to the door of all interested.

The Institute will also be of great international importance. Its staff will endeavour to make the results of their work known to the whole world, as has been the traditional custom of Russian savants. My firm conviction of its importance to international science has induced me to write of its origin and equipment to the scientists of the world. At the same time I take this opportunity of asking similar institutions in other countries to help towards the development and perfecting of our Institute by sending us scientific material, models for the museum, publications for the library etc. The Institute will be quick to acknowledge all such help and will consider it a pleasant duty to give in exchange its own productions as well as by publication to spread widely the result of its scientific researches.

I. A. KOUCHARENKO.

INTERNATIONAL ASSOCIATIONS

PROCEEDINGS OF THE INTERNATIONAL SOCIETY OF SOIL SCIENCE

Papers.

CELLULOSE AND ITS DECOMPOSITION IN THE SOIL BY MICRO-ORGANISMS.

The literature on the decomposition of cellulose in nature is growing daily, owing to the fact that this substance or group of substances forms the largest single constituent of plant tissues introduced in great abundance into the soil, in the form of animal manures, green manures and various plant residues. Notwithstanding the numerous contributions to the subject, we still know comparatively little concerning the organisms active in the decomposition of cellulose and the chemical processes involved. Since most investigators of soil organisms were looking for bacteria active in the particular processes under examination, and since the bacteria decomposing cellulose are rather specific in nature, the difficulties are easily understood. The question of direct or indirect participation of celluloses in the formation of dark-coloured organic residues in the soil has also called forth recently considerable discussion, especially from the point of view of the origin of peat and coal. The following paper is a summary of the investigations on the decomposition of celluloses by micro-organisms carried out at the Department of Soil Chemistry and Bacteriology of the New Jersey Station by the author and his associates.

MICROORGANISMS CONCERNED IN CELLULOSE DECOMPOSITION IN THE SOIL.

Micro-organisms capable of decomposing celluloses in the soil are found among bacteria, fungi, and actinomyces. The ability

of protozoa and other invertebrate animals to decompose cellulose in the soil still remains to be investigated.

Various attempts have been made to classify the cellulose decomposing bacteria into aerobic and anaerobic forms, thermophilic and denitrifying forms, but it is doubtful whether any sharp lines of demarcation can be drawn between the different groups, since a thermophilic form may be at the same time an anaerobic organism or may be capable of reducing nitrates to atmospheric nitrogen. If any division is to be made among the bacteria decomposing celluloses, it should not go further than the separation into the aerobic and anaerobic species and even here the division is not very sharp. Each of these two grou s may of course contain thermophilic and non thermophilic forms, organisms capable of bringing about the complete reduction of nitrates and those that are unable to do so. The group of aerobic bacteria includes a number of species capable of decomposing pure celluloses with a varying degree of rapidity; here belong spore-forming and non-spore forming bacteria, rod-shaped forms, spherical and spirochaete-like forms.

Very few of the anaerobic bacteria capable of decomposing celluloses have been so far isolated in pure cultures, so that it is impossible to say at present whether these represent various forms or only limited groups of organisms.

It is not a difficult matter to demonstrate the presence of aerobic bacteria in the soil capable of decomposing celluloses, isolate them and even count them or obtain approximate information as to their abundance in a given soil. For the study of the various organisms isolated by KELLERMANN and his associates (8,9), cellulose-agar can be used. A number of organisms can be thus isolated which form a range of varieties, as demonstrated by a study of their cultural characteristics and morphology, but which can be included into two or three groups or species. These organisms decompose cellulose only to a limited extent and can grow readily on media containing other sources of carbon than cellulose. However, the soil harbors various cellulose-decomposing aerobic bacteria, which prefer cellulose as a source of energy and which cannot even grow with any other carbon source. Ordinary agar media are unsuitable for the study and isolation of these organisms. Silica gel media containing cellulose as the only source of carbon and inorganic sources of nitrogen and minerals are very suitable for the study of these organisms (2, 16). Pure ground cellulose is suspended in a solution containing the ne-

cessary minerals in the proper concentration. The mixture is poured over the surface of a dialyzed silica gel plate and the excess of moisture is removed by drying the plate at 55°-60°C. The plates are inoculated with particles of soil and incubated at 28°-30°C. Growth will take place in the form of yellow or orange spots, within 2 to 4 days, around the soil particles. By diluting the soil with various volumes of sterile water, then adding some of the final dilutions to a series of plates, the approximate number of these bacteria can be determined.

Anaerobic bacteria capable of decomposing cellulose are present in the soil only to a very limited extent. This can be demonstrated by adding paper to the soil and introducing enough water to saturate the soil ; the decomposition of the cellulose will proceed in a normal soil saturated with water at first very slowly. This is due to the fact that the fungi and aerobic bacteria (as well as the actinomyces), which are very active in the decomposition of cellulose under aerobic conditions in normal soils are prevented from attacking the cellulose, while no extensive flora exists in normal soils which would decompose celluloses, when the soil is covered with water. This flora, consisting of anaerobic bacteria has only to be developed. Decomposition of cellulose under anaerobic conditions will take place only after a month or more has elapsed. But once decomposition sets in, it proceeds very rapidly. When cellulose is again added to such an active soil, decomposition sets in immediately. Decomposition of cellulose under anerobic conditions is carried out largely by spore-forming bacteria, with the formation of acids and gases (10).

When cellulose, in the form of ground filter paper, is added to the soil and the resulting increase in the development of micro-organisms is determined by the ordinary plate method (14), it is found that bacteria and fungi developing on the plate are both stimulated, but to a different extent, depending upon the soil conditions (17,18). As shown in Table I the addition of nitrogen to a soil receiving a heavy application of cellulose brings about a decided increase in the rapidity of cellulose decomposition. This is accompanied by a decided increase in the number of fungi and bacteria. Nearly all the fungi decomposing cellulose in the soil are capable of developing on the agar plate and, in spite of the various limitations of the plate method for determining the abundance of fungi in the soil, the results thus obtained can still serve as an index of the development of fungi due to the addition of cellulose to the soil. However, the increase in the numbers of bacteria resulting from the addition of

TABLE I. — *Influence of 1 per cent. cellulose, with and without $NaNO_3$ upon the development of micro-organisms in the soil after 17 days.*

Soil	Soil reaction	$NaNO_3$ added	Fungi		Bacteria (including Actinomyces)	
			Start	End	Start	End
	pH	per cent.				
Unlimed and manured soil.	5.4	0	87,300	320,000	6,500,000	21,400,000
		0.1	87,300	3,100,000	6,500,000	40,600,000
Limed and unmanurred soil	6.5	0	20,000	47,000	7,760,000	17,400,000
		0.1	20,000	290,000	7,760,000	47,200,000

cellulose to the soil, as determined by the plate method, is not due necessarily to an actual increase in the cellulose decomposing bacteria, since these do not develop at all or only to a very limited extent on the ordinary synthetic medium used for counting soil bacteria. The increase in the cellulose decomposing bacteria has to be followed by special methods. The bacteria developing on the ordinary plate, as a result of cellulose decomposition, are secondary organisms which either decompose the products formed from the cellulose by the fungi and the cellulose-decomposing bacteria or which utilize as sources of energy the cells of these organisms themselves.

Table II shows that the addition of an excess of water greatly represses the presence of fungi in the soil as well as of bacteria developing on synthetic media under aerobic conditions. A direct determina-

TABLE II. — *Decomposition of celluloses and the development of bacteria and fungi in the soil, in 26 days.*

Cellulose added	$NaNO_3$ added	Moisture content (on basis of waterholding capacity)	Fungi		Bacteria and actinomyces	Cellulose decomposed
			Plate method	Microscopic method (*)		
per cent	per cent	per cent				per cent
0	0	50	54,400	1	8,000,000	—
0	0	100	18,000	0	800,000	—
0	0.1	50	62,000	1	8,200,000	—
0	0.1	100	24,700	0	2,100,000	—
1	0	50	120,000	3	16,800,000	20.8
1	0	100	20,000	0	1,000,000	33.1
1	0.1	50	340,000	4	71,000,000	84.2
1	0.1	100	20,200	0	17,300,000	20.6

(*) The figures indicate the relative abundance of fungus mycelium, as demonstrated microscopically.

tion of the abundance of *fungus mycelium* using the microscopic method, and staining the soil with methylene blue (6, 17) reveals a marked parallelism between the numbers of fungi as determined by the plate method and the relative abundance of the mycelium as indicated by the microscopic method. The addition of nitrogen to the soil greatly hastened the decomposition of cellulose under aerobic conditions, where fungi and aerobic bacteria are active, but not under anaerobic conditions, where anaerobic bacteria are entirely concerned in the process.

Various experiments established the fact that in humid acid soils fungi are largely responsible for the decomposition of celluloses. Whenever the fungi are eliminated cellulose decomposition comes to a standstill. The elimination of the fungi can be accomplished by treating the soil with volatile antiseptics or heating to 65°-75° for 1 hour. When partially sterilized soil is inoculated with fresh soil, cellulose decomposition takes place very rapidly, even more so than in untreated soil; this is accompanied by an extensive development of the fungi, as can be demonstrated both microscopically and by the plate methods (17).

The fungi decomposing celluloses are represented in the soil by a number of genera, including *Aspergillus*, *Penicillium*, *Trichoderma*, *Fusarium*, *Verticillium*, *Cephalosporium*, *Humicola* and others. The *Phycomycetes* do not decompose true celluloses. The type of fungi developing in the soil as a result of the addition of celluloses depends on the reaction of the soil, moisture content, and the nature of the available nitrogen.

The actinomyces capable of decomposing celluloses are represented in the soil by several species. Owing to the fact that these organisms do not grow at a greater acidity than pH 5.0 and owing to their slow growth, they are active in this process only to a limited extent and under certain conditions (17).

Nature of cellulose decomposition by micro-organisms. — The process of cellulose decomposition can be followed either by measuring the disappearance of the original cellulose added to the soil or by the evolution of CO_2 in the soil receiving the cellulose in excess of that evolved by the soil not receiving any cellulose.

By extracting the cellulose from the soil with SCHWEIZER's reagent and precipitating the extract with hydrochloric acid and washing, the amount of cellulose left in the soil undecomposed can be determined (3). A definite amount of cellulose, in the form of

ground filter paper, is added to the soil and, after various periods of incubation, the soil is analysed for residual cellulose. The amount of cellulose decomposed is found to depend on the moisture content of the soil, reaction and aeration, which determine the type of organisms participating in the decomposition processes, and upon the period of incubation and the amount of available nutrients, especially nitrogen, which modify the quantity of cellulose decomposed under a given set of conditions. The controlling influence of the available nitrogen upon the amount of cellulose decomposed is readily understood when one keeps in mind the fact that the micro-organisms synthesize a definite quantity of cell substance for every unit of cellulose decomposed; the greater the amount of cellulose decomposed the greater is the quantity of cell substance synthesized and, since this cell substance is more or less definite in composition, the greater will be the amount of nitrogen and minerals required. A definite ratio has been found to exist between the cellulose decomposed and the nitrogen transformed by the micro-organisms from an inorganic to an organic form, this ratio being about 30-35 to 1, *i. e.* for every 30 to 35 parts of cellulose decomposed in the soil by micro-organisms 1 part of soluble nitrogen is required. Since the available nitrogen is present in the soil only in limited amounts, the rapidity of cellulose decomposition will be controlled in ordinary soil by the rapidity with which the nitrogen is made available (15). Of course when the period of incubation is prolonged, the ratio will become wider and wider, since the synthesized cells of the micro-organisms will be in their turn decomposed and a part of the nitrogen will again be made available and will be utilized for a further decomposition of more cellulose. This is also the reason why in soils of different fertility cellulose will be decomposed at different rates, since the more fertile the soil the more rapid and abundant is the liberation of the nitrogen and minerals in an available form (Table III).

The ideas of CHRISTENSEN (4) that the ability of the soil to decompose cellulose can serve as an index of its fertility, of NIKLEWSKI (12) that the decomposition of cellulose in the soil is largely controlled by the presence of available nitrogen, of CHARPENTIER (3) and BARTHEL and BENGTSSON (1) that the favourable influence of manure upon cellulose decomposition is due to the presence of available nitrogen and not to the introduction or a new microflora are thus confirmed and explained. The more fertile a soil is, the

TABLE III. — *Influence of available nitrogen upon the decomposition of cellulose in soils of different fertility.*

$NaNO_3$ added to 100 gm. of soil	Cellulose decomposed (1 per cent added)	
	Unfertile soil, 6 weeks incubation	Fertile soil, 4 weeks incubation
mgm	per cent	per cent
0	36.9	42.2
25	41.7	66.7
100	59.7	97.2

greater will be the amount of nitrogen liberated in the form of ammonia and nitrate in a given period of time. Since the quantity of cellulose decomposed in a given soil is in direct relation to the available nitrogen, the more rapidly this nitrogen is liberated from the complex organic nitrogenous compounds of the soil the more rapidly will the cellulose be decomposed by the micro-organisms in the soil. This points to the futility of all the attempts made in the past to inoculate the soil with bacteria or other organisms which decompose the soil organic matter more actively than the native flora. A change in soil conditions as a result of treatment will bring about a corresponding change in the flora. The introduction of a supposedly "more vigorous flora" will prove of no consequence when the soil conditions are not favorable for this flora.

The decomposition of cellulose in the soil can also be followed by the course of evolution of CO_2. This method first suggested by NIKLEWSKI (12) has the advantage over the direct determination of residual cellulose in that the process can be followed uninterruptedly for any length of time. The amount of CO_2 produced from the control soil is of course subtracted from the CO_2 produced from the soil to which cellulose has been added, the assumption being that the decomposition of the soil organic matter is not influenced by the addition of cellulose.

The carbon liberated as CO_2 forms only a part of the cellulose decomposed. This is due to the fact that part of the carbon is stored away in the form of cell-substance or other synthesized materials, and part is left in the form of various intermediary substances or products of cell metabolism. The latter is especially abundant in the decomposition of cellulose under anaerobic conditions. The ratio of the carbon liberated as CO_2 to the carbon of the cellulose

decomposed will thus depend upon the nature of the organisms which bring about the decomposition of the cellulose. In well aerated soils where fungi and various aerobic bacteria are the most active agents in the process of cellulose decomposition, about 50 to 65 per cent. of the carbon of the cellulose may be liberated as CO_2, about 30 to 35 per cent. of the carbon utilized for the synthesis of cell substance, and only about 5 per cent. left in form of intermediary products. Under anaerobic conditions only about 20 per cent. of the carbon of the cellulose decomposed may be liberated as CO_2 and a small amount of it utilized for synthetic purposes, while a large part of the carbon is left in the form of organic acids or liberated as methane. The results in Table 4 show the ratio between the cellulose decompo-

TABLE IV. — *Decomposition of* 1 *per cent. cellulose by a pure culture of Tricoderma in sterile soil.*

Incubation	Cellulose decomposed	CO_2 produced (excess over control)	Nitrogen assimilated	Dry mycelium synthesized	Cellulose decomposed / Nitrogen assimilated	Economic coefficient	Respiration equivalent	Plastic equivalent
days	*mgm. C.*	*mgm. C.*	*mgm. N.*	*mgm.*			*per cent.*	*per cent.*
7	281.9	114.2	17.9	378.0	35.1	1.7	40	59
14	389.4	179.9	20.4	472.0	43.1	1.8	46	54
21	400.0	209.5	21.7	429.0	41.1	2.1	52	47

sition, nitrogen assimilation, synthesis of cell substance and CO_2 evolution by a pure culture of a fungus (*Trichoderma* sp.) grown in sterile soil to which a synthetic solution containing a definite amount of nitrogen and minerals has been added. The economic coefficient indicates the ratio $\dfrac{\text{cellulose decomposed}}{\text{dry mycelium synthesized}}$;

$$\text{respiration equivalent} = \frac{\text{carbon of } CO_2 \text{ liberated}}{\text{carbon of cellulose decomposed}}$$

$$\text{plastic equivalent} = \frac{\text{carbon of mycelium synthesized (6)}}{\text{carbon of cellulose decomposed.}}$$

Role of cellulose in the formation of " humus " in the soil. — The literature of soil science is full of statements concerning celluloses as the mother substances of soil " humus ". Even among the most

recent contributions to the origin of coal, various suggestions are made as to the probable processes whereby cellulose is converted into " humus " then into coal (11). Some claim that celluloses give rise to dark coloured substances, similar to the formation of dark bodies when sugars are boiled with acids or alkalies. Others claim on the other hand, that celluloses are decomposed completely without leaving any residual materials and they cannot serve, therefore, as the mother substances of " humus ". Unfortunately most of these claims are not based on experimental evidence, but are pure and simple speculations.

As a result of numerous experiments on the decomposition of cellulose, under aerobic and anaerobic conditions by bacteria, fungi and actinomyces in pure and mixed cultures, it can be stated definitely that celluloses do not contribute directly to the soil organic matter or " humus ". Celluloses are, next to the sugars and starches, among the most readily decomposable constituents of the plant material commonly added to the soil. All soils harbor numerous organisms capable of attacking celluloses. These will be decomposed under aerobic or anaerobic conditions completely ; in the first case to CO_2 and water, in the second case with the formation of various organic acids and gases. No dark coloured substances are ever formed from pure celluloses. Practically 100 per cent. of the carbon of the cellulose decomposed can be accounted for by the cell substance synthesized and by the intermediate and final products formed including the CO_2.

Indirectly however celluloses do contribute to the accumulation of organic matter in the soil (" humus ") which is more or less resistant to decomposition. As pointed out above a part of the carbon of the cellulose, amounting to as much as 30 to 40 per cent. in the case of fungi, is utilized by the organisms for the synthesis of cell material. This newly synthesized substance can again undergo decomposition, but not completely ; only a certain part of this cell substance is readily decomposed by other organisms. A certain part amounting to 20 per cent. or more of the synthesized cell substance is resistant to decomposition and possesses all the properties which are characteristic of the soil " humus ". A detailed study of the origin of " humus " in the soil, from the point of view of microbiological processes, is now in course of publication.

SUMMARY.

1. In normal aerated soils, celluloses are decomposed largely by fungi, certain aerobic bacteria and to a lesser extent by *actinomyces*.

2. Anaerobic bacteria capable of decomposing celluloses are present in normal soils only to a very limited extent but are found abundantly in bog soils.

3. The aerobic bacteria capable of decomposing celluloses are represented in the soil by a number of groups, some of which are very active while others bring about only a disintegration of cellulose fibres. Some of these bacteria, especially the active forms, cannot use any other source of carbon but celluloses.

4. The fungi are represented in the soil by a large number of species capable of decomposing true cellulose. The *Phycomycetes* are unable to carry out this process.

5. Among the numerous actinomyces found in the soil, only a few species are capable of decomposing celluloses actively.

6. The type of organisms taking an active part in the decomposition of cellulose added to a given soil will depend upon the nature of the soil, its reaction, moisture content and presence of available nutrients. A special set of conditions will favour the development of certain organisms, which bring about the decomposition of celluloses in preference to others.

7. The decomposition of cellulose in the soil can be measured quantitatively either by the disappearance of the cellulose or by the evolution of CO_2, especially under aerobic conditions.

8. Celluloses are decomposed completely by micro-organisms in the soil ; under aerobic conditions, part of the carbon of the cellulose decomposed (50 to 65 per cent.) is liberated as CO_2, part of the carbon (25-35 per cent.) is utilized by the organisms for the synthesis of cell substance and only a small part (5-10 per cent.) is left in the form of intermediary products. Under anaerobic conditions, a much smaller part of the carbon of the cellulose decomposed is liberated as CO_2 and is assimilated by the organisms, while a considerably greater part is left in the form of various intermediary products largely organic acids.

9. There is a definite ratio between the amount of cellulose decomposed and the nitrogen required by the organisms for the synthesis of cell substance. This ratio is usually 30 to 35 in the case of fungi. It becomes wider in the soil, with a mixed flora, and with continued incubation, especially in the absence of an excess of nitrogen, due to the constant liberation of more nitrogen from the soil organic matter and especially from the cell substance previously synthesized.

10. Directly cellulose does not contribute to the formation of "humus" in the soil. Indirectly, namely through the cells of the micro-organisms, it does. Since a certain part of the carbon of the cellulose decomposed is reassimilated by the organism for the synthesis of cell substance, and since a part of this synthesized material is resistant to further rapid decomposition, a part of this material will become an ingredient of the soil "humus".

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PREPARATION OF A SOIL FOR PRACTICAL SUSPENSION ANALYSIS

To enable us to get the most exact values for the final physical composition of a soil, the different suspension apparatus in use have been considerably improved in recent years. But not to lose anything from this increase in precision, one has to take all the care possible to eliminate every possible source of error from the *preliminary preparations* of the soil for suspension analysis. It is this preliminary preparation of the soil, by the methods now in use, that leaves much to be desired. The procedure proposed by the standardisation section for amelioration in 1924 was as follows: the fine soil, of below 2 mms., is soaked during the night and then boiled for an hour. The soil so treated is then thoroughly pounded several times, with constant changing of water, until the water shows no turbidity: only then starts the real suspension method (1). It is quite evident that this energetic rubbing may according to the character of the soil introduce considerable errors, e. g., the small part-weathered fragments of stone, which would have kept their same composition undisturbed in the soil for many years, are often crushed to atoms by this pounding. And the same applies to silt particles and still finer material. In this way the final composition of the resulting material is quite unlike that of the original soil sample, being finer and much richer in clay. And this difference will be the more pronounced the richer the soil originally was in weathering material, the more closely it approached in character a definite type of soil, and the softer the original material was. If the soil particles are unaffected by prolonged soaking and boiling, it can be assumed that under the influence of the slow prolonged weathering in the soil they will keep their original composition for long enough to give the soil definite physical characteristics which are not the

(1) The preparation of the soil by simple shaking without warming has, so far, not yet been generally accepted, and hence it is impossible to take up a critical attitude with regard to it.

same as those produced by the same particles energetically pounded to bits. It is therefore not a criterion of purity of a given particle determination that after suspension nothing further can be rubbed off (especially if the products of suspension have been dried on the water-bath or in the hot-air oven, i. e. at a high temperature !). To decide properly the question of purity the microscope must be used.

Boiling has this advantage that the constant agitation keeps the particle in an uninterrupted whirling motion, and this motion by rubbing the particles *gently* against each other rubs off the adhering clayey coating, without, hurting its physical constituents as does the *energetic* rubbing. But the disadvantage of boiling is that, despite the uniform warming of the water and soil, tension is set up, which may cause a disintegration of the different small stones or stone particles present, and this the more readily, the nearer the given soil sample originally was to the weathering zone. This also leads to errors varying with the character of the minerals in the soil. Boiling of a soil sample is also inadvisable because of the danger of coagulation of the smallest particles when the " suspension residues " have to be still further separated into their different sized particles.

Thus boiling or strong rubbing are very similar in their action to the boiling of a soil sample with concentrated hydrochloric acid, as in chemical soil analysis, since, in both cases we are doing something rarely accomplished by weathering.

The best method of preparation of soil samples for analysis would therefore be one, possessing all the advantages of the boiling method without the sources of error introduced by heating i. e. a kind of " cold heating ". By placing some soil soaking in water in a vessel attached to an air pump and drawing for an hour a current of air from below through the soil-water mixture, so as to keep the mass in an agitated condition, the author believes he has got very near to our " cold boiling ". The KOPECKY method of suspension analysis, using 25 gms. of soil, as employed in most laboratories, makes it possible to use for the above preparation of the sample the usual laboratory water-pump, unless indeed we are dealing with an extraordinarily coarse soil, in which case the sample must be divided up. The " cold boiling " is the more vigorous and the current of air passing through the mixture is greater, the smaller the difference between the diameters of the mouth of the pump and that of the glass vessel. In addition the glass vessel must be capable of holding enough water to enable a

PLATE XXXVII

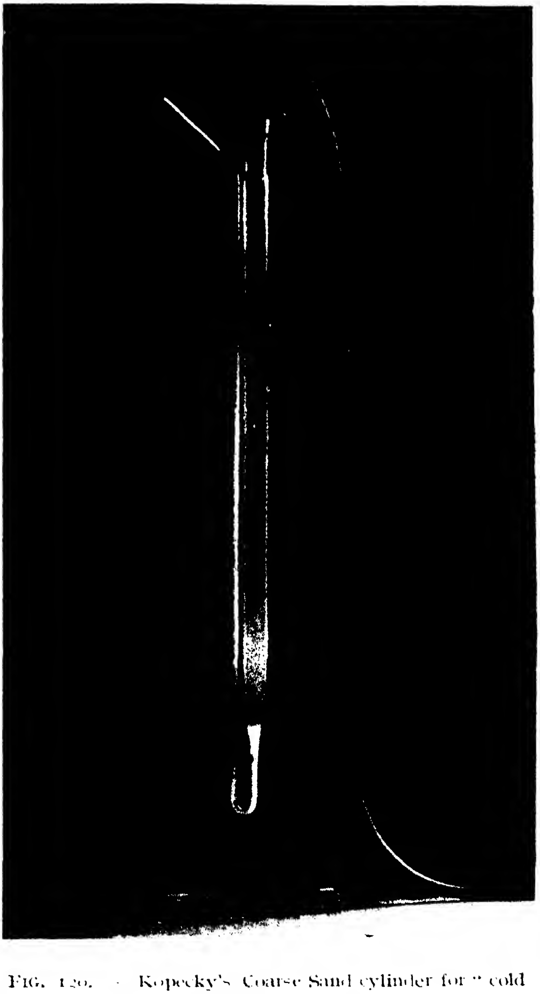

FIG. 120. — Kopecky's Coarse Sand cylinder for "cold boiling" soil samples.

proper agitation of the earth to be kept up, and there must be space enough above the column of water to make it impossible for anything from the water-soil mixture to be carried away by the air current. From among all the different vessels present in every soil science laboratory, the coarse-sand cylinder of KOPECKY seems the best for the carrying out of the " cold boiling ". The illustration shows the arrangement of the apparatus.

The far-end side piece, after it has been half filled with the soil-sample and water for soaking, is attached by means of a rubber cork and a piece of ordinary tubing to the water pump (pressure tubing must not be used, to prevent the production of an excessive pressure and the smashing of the glass vessel). Through the narrow, open end, a constant current of air is drawn from below through the column of water, at such a rate, that about 150 agitations are produced in the mixture in a minute. Certain rules and precautions will occur to any one who has experience in suspension analysis e. g. that the narrow, open end, shall, when filling, be closed by a piece of rubber tubing and a pinch cock, and opened only *after* the pump has started working, so as to prevent sucking back and choking of the narrow end by earth, or that water can be added to the open end when the earth shows a tendency to stick in the bend. This method of preparing soil samples for analysis has also this advantage that the apparatus can be left working for any desired length of time, without having to add water or pay any further attention to it.

The correct procedure is then as follows: the fine soil is soaked in water and after a time the larger lumps are crushed with the fingers, so as to allow a better penetration of the water. After soaking for several hours, preferably the whole night, the soil sample is then treated for an hour with the air-pump, after which the suspension analysis is proceeded with in the usual prescribed manner.

Although it is intended to deal with the preparations for suspension analysis of the different, separate types of soil e. g. the special treatment required by humus soils, in a later and special paper, yet, I would point out now in a number of soils the differences produced in the KOPECKY suspension analysis by the different ways of preparation treatment. In the work described in the table given, carried out by the author in collaboration with Dr. HENKEL, examples are given not only of samples treated by the air pump method but also of those treated by the boiling method but without excessive pounding, so that differences in results can be attributed solely to the

application of heat. The results prove that the different soil-samples have behaved very differently. While some underwent very little change on heating others suffered considerable disintegration.

Differences in the results of Kopecky's suspension analysis due to differences in preliminary treatment.

Soil	Preliminary treatment	Coarse sand	Fine sand	Silt	Cyla
		%	%	%	%
Alluvial sandy moor soils	boiled	65	4	7	24
	air pump	72	16	2	10
Jurassic sandy soils	boiled	8	59	13	20
	air-pump	9	60	14	17
Marshy sandy soils	boiled	19	21	31	29
	air-pump	19	22	34	25
New Red Sandstone soils	boiled	34	58	1	7
	air-pump	33	59	2	6
Oberrortliegendes Sandy loamy soils	boiled	20	22	20	38
	air-pump	21	23	17	39
Lettenkohl loamy soils	boiled	20	16	10	54
	air-pump	28	15	9	48
Loess loamy undersoil	boiled	11	10	27	52
	air-pump	12	10	51	37
Keuper, clayey soil	boiled	8	12	26	54
	air-pump	9	19	32	40
Alluvial clayey loamy soils I.	boiled	24	14	17	45
	air-pump	28	19	11	42
Subsoil of above	boiled	15	19	11	55
	air-pump	21	29	18	32
Alluvial clayey loamy soils II.	boiled	6	20	17	57
	air-pump	13	28	22	37
do III	boiled	17	12	20	51
	air-pump	29	18	21	32
do IV	boiled	23	12	13	52
	air-pump	30	14	13	43
Clayey soils of the upper shell limestone	boiled	6	6	26	62
	air-pump	5	5	7	83
Clayey soil of the lower gypsum Keuper	boiled	8	10	20	62
	air-pump	7	11	26	56
Clayey soils of the lower Rotliegenden	boiled	12	13	18	57
	air-pump	13	13	22	52
Keuper Fireclay	boiled	34	58	1	7
	air-pump	33	59	2	6

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BACTERIOLOGICAL METHODS FOR THE INVESTIGATION OF SOIL FERTILITY.

During the infancy and early stages of soil bacteriology in the later decades of the nineteenth century, great expectations were aroused as to the information that this science might give on the conditions of soil fertility. However as these expectations were subject to some disappointment, the whole question is now made the object of more sober consideration. Still we must not infer that scientific research has lost interest in that branch of soil science — on the contrary — all over the world, the numerous and important problems which soil bacteriology presents, are being made the subject of careful study, especially those dealing with the relation of soil microorganisms to the chemical and physical factors governing soil fertility.

Two main directions are followed: 1) Floristic research (qualitative and quantitative studies on the composition of the soil's microflora), and 2) Physiological research (studies on the changes in soil matter).

1. Floristic Research.

The determination of the soil content of microorganisms — the basis of all study along this line in the early days of soil bacteriology — was almost completely abandoned after 1902, when Remy introduced experiments in quantitative decomposition. However of late the former method has been largely resumed, not only as an auxiliary but also as a comparatively independent method for studying soil fertility. It was with this method that Hiltner and Stoermer (1903) and Russell and Hutchinson (1909-12) made their fundamental studies on partial sterilization of soil, while a number of other investigators — Fabricius and Feilitzen (1905), Egberding (1909), Temple (1911), Fisher (1909-1911), Bear (1917) — to name only a few — have used it for the study of the influence of lime, stable manure etc. on the microflora of the soil. Later H. J. Conn (1910-22) developed

the counting method to a very considerable degree and combined the plate counting method (using synthetic media of a well defined chemical composition) with a method for direct microscopic counting of micro-organisms, in soil suspensions. Even though the results of these two methods are far from identical (the direct counting method gives 5-20 or even 40 times as high figures as the plate counts, a result partially confirmed by WHITTLES (1923) and WINOGRADSKY (1925), the results were constantly found to run parallel when different soils were compared or when the number of microorganisms was increased by adding stable manure or other organic matter to the soil. The determination of the number of bacteria thus becomes, if not a picture of the total soil flora, at least an index of the bacteriological condition of the soil. CONN has chiefly used his methods for the study of the composition of the soil micro-flora, the seasonal variations in the numbers of bacteria and the relative importance of various groups of soil bacteria in the transformation processes in the soil. Quite recently the plate method has been further developed in England by THORNTON (1922), and FISHER, THORNTON and MACKENZIE (1922), and in the United States by LIPMAN and BROWN (1910), FRED and WAKSMAN (1922), WAKSMAN 1922*a* and 1922*b*. These studies show among other matters, that apart from the effect of less suitable media of an undefined and irreproducible composition the negative results so often obtained by earlier investigators must be largely due to the following facts : The number of bacteria in a given soil is, even under constant external conditions far from constant ; in the first place it may show remarkably large " rhythmical " fluctuations, often within periods of a few hours (THORNTON 1923) and secondly it varies inversely to the number of active protozoa and especially amoebae in the soil (CUTLER, CRUMP and SANDON 1922). Furthermore as the number of bacteria in a seemingly uniform soil plot varies greatly within closely adjacent localities, in making investigations so many duplicate samples, each a composite of several individual samples, should be taken that the variability in bacterial numbers can be determined and a reliable account made for the experimental error (FISHER, THORNTON and MACKENZIE, 1922, WAKSMAN, 1922). Finally not only should the numbers of bacteria be considered but attention should also be given to the other groups of heterotrophic soil organisms, especially actinomycetes and fungi. (WAKSMAN, 1922). When these points are duly taken into consideration in connection with fertilising experiments in the field, it is possible, as shown by WAKSMAN (1922) the most thor-

ough student of the problem, to obtain results which show a distinct correlation between crop producing power and number of bacteria and actinomycetes in the soil. WAKSMAN (1921) has also worked out a special method for making quantitative determination of the number of fungi in the soil. The number of micro-organisms and especially the ratio of fungi to bacteria and actinomycetes may not only be determined by the amount of plant nourishment in the soil, but is also to a marked degree influenced by the reaction of the soil, the fungi predominating in acid, and bacteria and actinomycetes in neutral and alkaline soils. Our own investigations on a number of Danish soils have fully confirmed these facts. In another paper WAKSMAN (1917) has shown that fertile soils harbour greater numbers of fungi both as regards species and individuals than do poor soils. The fungous flora shows a certain relationship to soil character, soils from warm and dry regions being very rich in *Aspergilli*, whereas the *Mucorales* and *Penicillia* are the predominant forms in soils from colder climates, and the *Trichodermae* are specially numerous in strongly acid and water-logged soils. This has been found to a certain extent to hold good for Danish soils. The actinomycetes too show some relation to soil conditions, their relative number being high in neutral and alkaline soils, but in soils with a pH value below 5.0 both their relative and absolute number are very markedly reduced. This, however, has not been confirmed by the Danish soils. Later on WAKSMAN and STARKEY (1924) in a very interesting paper have shown that the micro-flora of soils of different fertility is differently affected by the addition of nutrients, and that the different effects show a correlation with the deficiency in plant food. Among more occasional observations on the positive correlation between bacterial numbers and crop-producing power mention should be made of the work of NOYES and CONNER (1919) and NELLER (1920).

Note should be made in this connection of the fact that S. WINOGRADSKY (1925) has quite recently worked out new refined methods for direct microscopic analysis of the microflora of the soil. The preliminary results reveal very striking differences between soils of different characters and further reports are awaited with much interest.

2. PHYSIOLOGICAL RESEARCH.

For an account of the physiological research work in soil fertility reference should be made to the report of HARALD R. CHRISTENSEN

delivered before the IV International Conference on Soil Science in Rome, 1924, in which is a detailed description of the " principle of inoculation " introduced by the author. This principle, based on microbiological matter transformation experiments, aims directly at estimating the influence exerted both by the actual microbiological and the chemical condition of the soil on the course of transformation in soil matter.

CHRISTENSEN'S studies, in which the principle of inoculation was used, dealt specially with mannite, cellulose, and peptone decomposition, and it was found that the course of these transformations under the given conditions is to a particular degree governed by the reaction condition and the supply of easily soluble phosphoric acid compounds. The principle seems to allow a microbiological determination of these and possibly also of other soil characteristics.

Since then other investigations have been made along these or similar lines. The following deserve mention :

a) *Mannite decomposition.*

WAKSMAN and KARUNAKAR (1924) found, in agreement with CHRISTENSEN (1922), that the addition of phosphates exerts a markedly beneficial influence upon mannite decomposition in acid and somewhat infertile soils (from unfertilised plots and plots constantly treated with physiologically acid fertilisers), while it was without any effect in fertile, nearly neutral soils. The authors have further observed a complete correlation between the speed of mannite decomposition and the amount of crop yield in soils from 7 differently treated plots in a permanent fertilising experiment.

b) *Cellulose decomposition.*

The determination of the speed of cellulose decomposition as an index of the supply of plant food in the soil and measured by the carbon production seems to have been suggested for the first time by B. NIKLEWZKI (1912). Recently C. CHARPENTIER (1921) has worked out a method for quantitative determination of cellulose in the soil and this has led to renewed interest in the study of the relation of cellulose decomposition to soil conditions. By means of this method CHARPENTIER was able to show that a soil's content of certain nitro-

gen compounds in a particular degree governed the rate of cellulose decomposition. The addition especially of stable manure accelerated the process. BARTHEL and BENGTSSON (1923) state that when soil is mixed with 1 % Cellulose and various amounts of ammonium salts, the amount of cellulose decomposed within a certain time is almost proportional to the amount of nitrogen added. The effect of stable manure is nearly proportional to its content of ammonium nitrogen, whereas its bacterial content seems to have no significance. WAKSMAN and HEUKELIKIAN (1924) arrive at similar results. By addition of cellulose to the soil and determination of its rate of decomposition they attempt to obtain an index of the content of available, i. e. readily nitrifying nitrogen in the soil. When sodium nitrate is also added, an index of the phosphorus compounds available for the cellulose decomposing micro-organisms is obtained. STARKEY (1924) using CO_2 production for measuring the decomposition rate, observes that cellulose and organic substances rich in cellulose, such as rye straw, are decomposed more rapidly in fertile than in poor soils, and in agreement with WAKSMAN and HEUKELIKIAN he notes that addition of nitrates has a far more pronounced effect in fertile than in poor soils (in which phosphoric acid now becomes the limiting factor).

C) *Protein decomposition.*

The results of the numerous investigations made by CHRISTENSEN (1914), and described in his lecture at Rome in 1924, to which reference has already been made, tend to show upon the whole that a weak power of peptone decomposition under all circumstances indicates decidedly unfavourable soil conditions. Soil reaction was found in a special degree to govern the speed of peptone decomposition. Otherwise the various scientists who have studied the protein decomposing power of soils in relation to soil fertility have reached very dissimilar and contradictory results. Several scientists, e. g. FISHER (1911) and TEMPLE (1919) find no correlation ; BROWN (1916) on the other hand finds correlation and BURGESS (1918) finds differentiation only between very fertile and very poor soils. WAKSMAN (1923) who has studied the problem very extensively, is convinced that the degree of ammonia production in solution or soil cultures only affords very incomplete information concerning soil conditions, and that the process is a function of too many variable factors to serve as a useful index of soil fertility.

d) *Nitrification.*

In earlier investigations CHRISTENSEN (1914), using solution cultures in which the nitrifying power is primarily governed by the number of nitrifying organisms introduced with the soil, noted no, or only slight differences between the nitrifying power of the individdual soils. Sphagnum peat in which nitrifying organisms were not found is an exception. In further studies, not yet published, it has been found that the nitrification rate of ammonium salts is primarily determined by the ability of the soil to neutralize the acids formed by the process — in other words — by the buffer effect of the soil. An unquestionable correlation between nitrifying capacity and soil productivity has however been shown to exist in many of the numerous experiments chronicled in the literature on the subject: ASHBY (1907), LOEHNIS (1905), GUTZEIT (1906), VOGEL (1910), KELLERMANN and ALLEN (1911), GREAVES (1913), LIPMAN (1914), BROWN (1916), BURGESS (1918), NOYES and CONNER (1919), WAKSMAN (1923 b and c), and others. This may probably in the main be explained by the well-known fact that the reaction condition of the soil may affect soil fertility to a very considerable degree. It is therefore important to realize that a nitrification experiment will generally furnish no other information on soil conditions than that which could be obtained by a chemical determination of the buffer effect of the soil. It is interesting to note in this connection that the fine correlation found by WAKSMAN (1923 c) between nitrifying capacity and crop production of unlimed soils is less pronounced in the case of limed soils; in the latter instance it was found that liming greatly stimulated nitrification in somewhat infertile soils without markedly increasing the crop yield, BEAR (1917), and BARTHEL and BENGTSSON (1920) agreeing in their results that the course of nitrification is first and foremost determined by the reaction and buffer content of the soil. This is, however to a certain degree complicated by the fact that according to the results of GAARDER and HAGEM (1920-23) and MEEK and LIPMAN (1922) strains of nitrifying organisms exist which possess different pH optima and pH limits for growth. This may partly account for the vigorous nitrification known to take place in certain acid forest soils WEIS (1910 and 1924), C. OLSEN (1921). That the course of nitrification depends so little on factors other than the reaction condition is probably related to the fact established by MEYERHOF (1916-17)

that the mineral nutrient requirements of the nitrifying bacteria are very minute. This fact will probably render an attempt to obtain indications of the mineral nutrient supply in soils by means of nitrification experiments hopeless.

e) *Nitrogen fixation.*

The dependence of nitrogen fixing bacteria on the reaction condition of the soil has manifested itself clearly in a number of various investigations. Those applied to *Azotobacter* have led to the working out of the so-called Azotobacter-test for the determination of the lime requirement of soils, and applied to the nodule bacteria of leguminous plants has led to research work on the relation of various nodule bacteria to soil reaction (FRED and DAVENPORT (1917) on several nodule bacteria, STEVENS (1919) on lucerne and sweet clover bacteria, BRYAN (1922-23) on lucerne, clover, and soya bean bacteria, and WRIGHT (1925) on soya bean bacteria). These investigations are valuable for ascertaining whether a given soil, as indicated by its reaction, is adapted to the cultivation of the leguminous plants in question. GAINEY (1918-23), GAINEY and BATCHELOR (1923), CHRISTENSEN (1923), CHRISTENSEN and TOVBORG JENSEN (1924) and E. J. PETERSEN (1925) have shown that the critical limit of acidity for the development of *Azotobacter chroococum* lies at pH 5.8-6.0 In a quite recent paper GAINEY (1925) shows in agreement with earlier similar experiments of CHRISTENSEN (1914) that *Azotobacter* will soon die out if introduced into soils with acid reaction. WAKSMAN and KARUNAKAR (1914) using experiments with a number of soils of different fertility and mixed with 1 % mannite have found that no nitrogen fixation occurs in soils with pH value below 6.0, whereas it was more or less vigorous in soils having a higher pH value. The same authors, studying the nitrogen fixation in a 2 % mannite solution inoculated with 5 % soil obtained no correlation between the intensity of nitrogen fixation and soil productivity. Judging from these results nitrogen fixation seems in a high degree to be determined by *Azotobacter*, the presence of which undoubtedly indicates favourable soil conditions. Besides requiring definite reaction conditions, Azotobacter has a definite rigid need of available phosphoric acid compounds, a fact upon which CHRISTENSEN (1914) and recently NIKLAS and HIRSCHBERGER (1924) based a biological test for the determination of easily soluble phosphoric acid compounds in the soil. BEIJERINCK (1925) has recently

described a new Nitrogen fixing bacterium said to be rather characteristic of poor soils.

f) *Carbon dioxide production.*

The carbon dioxide producing power has often been suggested as an index of the total microbiological activity of the soil. Such determinations were first carried out by PETERSEN (1870) and WOLLNY (1897). Since then numerous scientists have dealt with the problem, though we can only mention here a few of the papers: STOKLASA and ERNEST (1905) considered the carbon dioxide production by soil bacteria to be of much importance in rendering phosphoric acid compounds available to higher plants. HESSELINK van SUCHTELEN (1910) noted that the carbon dioxide production reacted more readily to the addition of nutrients to the soil than did the bacterial numbers. LEMMERMANN, ASO, FISCHER and FRESENIUS (1911) who have carried out extensive studies on carbon dioxide production in the soil observed that this production from organic matters, such as vetch straw, horse manure, and green rye, was stimulated by small amounts of lime, while heavier doses sometimes had the contrary effect. STOKLASA (1912) found a positive correlation between bacterial numbers, carbon dioxide producing capacity, and soil productivity. NELLER (1920) found a more vigorous carbon dioxide production in limed than in unlimed soil. WAKSMAN and STARKEY (1924 a) distinguish between " respiratory power " (CO_2-evolution from the untreated soil) and decomposition power " (CO_2-evolution from soil + 0.5 % dextrose); they find the " respiratory power " correlated with bacterial numbers, the nitrifying power, and the crop producing power; the same holds true, to a certain degree, of the " decomposing power ". However a soil treated with physiologically acid fertilisers behaved abnormally; although its productivity was very poor and its respiratory power weak, it had a strong decomposing power because of the very active fungous flora, to which the treatment had given rise. Studies on the problem are at present being carried out at the State Laboratory of Plant Culture, Denmark.

g) *The carbon-nitrogen ratio in the soil.*

This has quite recently been made the object of some very noteworthy considerations by WAKSMAN (1924) who calls attention to the fact that the amount of nitrogen liberated as ammonia + nitrates

depends upon the quantity and quality of carbon compounds available as sources of energy, and the nature of the organisms which consume them. The fungi, which are gigantic organisms in comparison with the bacteria, have a more economic metabolism than the latter and synthesize large amounts of protoplasm ; therefore when a certain amount of carbon food is consumed and transformed into microbial protoplasm and respiration products by fungi, far greater amounts of nitrogen are assimilated than is the case when the same amount of carbon food is consumed by bacteria. The actinomycetes stand midway between the two other group. An example taken from practical agriculture may be quoted : cellulose is, according to WAKSMAN and HEUKELIKIAN chiefly decomposed by fungi, especially in acid soils ; this accounts for the unfavourable effect of straw manuring, undoubtedly due more to assimilation of soluble nitrogen than to denitrification.

These circumstances seem to explain a part of the function of lime in the soil ; in acid soils, which harbour a great number of fungi in proportion to bacteria, large amounts of nitrogen are constantly kept assimilated as fungous mycelium — CONN (1922) has indeed by direct microscopical investigation found fungous mycelium especially abundant in acid soils containing much undecomposed organic matter —, because a relatively large amount of carbon food is constantly added in the form of plant residues poor in nitrogen. When such a soil is limed the bacteria and actinomycetes find a favourable reaction, and are enabled to compete with the fungi and carry out a relatively greater part of the soil metabolism. The decomposition of the organic nitrogen compounds now takes another course which results in liberation of more ammonia and nitrates than hitherto. A determination of the reaction condition of the soil and of the carbon-nitrogen ratio will therefore be of much value for the understanding of the course of microbial matter transformations in soil.

Speaking generally it is important to realize that the soil bacteriological investigations briefly sketched here have very considerably extended our knowledge of the soil micro-flora and the conditions of its development in directions favourable or unfavourable to agriculture. Particular stress should, as hitherto, be laid upon special studies of morphological and physiological character, although, with knowledge such as we have at present, it is premature to accept uniform, standardised bacteriological methods for estimating soil fertility. Regarding the question of a rational development of that part

of soil bacteriology concerning the influence of soil conditions on bacterial life and metabolism in the soil, attention should be called here to the vast importance of using methods already tested in connection with reliable vegetation experiments (pot or field experiments) and especially with permanent fertilising experiments, in which the estimation of crop development and the variations caused in the chemical condition of the soil furnish a reliable control of the influence of the factors in question upon plant growth. We shall then be able to judge of the value of the methods used for the study of soil fertility. We suggest therefore that such experiments be carried out in great numbers in the different countries of the world under various conditions of soil and climate. In the extensive bacteriological research work in connection with experiments of this kind, international co-operation in the form of interchange of soil samples, for instance, would be very desirable.

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Abstracts and Literature.

Soil Physics.

Temperature and Salinity.

Cotton Research Board, Fourth Annual Report 1923.

Part V of the report of the Cotton Research Board for the year 1923 states the researches prosecuted by Mr. MACKENZIE TAYLOR during that year on temperatures and on freeing the soil from salt. The writer studied the temperature of the soil during the fallow period, called the sharaqi period, and the effects of these temperatures from the point of view of the partial sterilization of the soil, which he considers as the principal benefit of the sharaqi period.

The observation of surface temperatures has enabled the sharaqi to be divided into three periods :

(*a*) a warming up period up till about 1st July, during which no partial sterilization is produced ;

(*b*) a period of high temperature, from the 1st July up to the 21st August which corresponds with an active partial sterilization ;

(*c*) a period of diminished temperatures, after the 21st August, corresponding with a decline of the partial sterilization.

Now since the introduction of perennial irrigation which allows of summer crops, the area of lands subjected to the sharaqi regime has been decreasing at the same time as the sharaqi, period has been becoming shorter consequent on the earlier planting of maize, which takes place in July at precisely the period when fallowing is most beneficial.

The experiments undertaken by the writer have shown that it would be profitable, in order to obtain subsequently higher yields of cotton, to postpone the sowing of maize until the 10th August. In studying the effects of summer fallow on the soil protozoa in Egypt, the writer remarked, that in spite of the partial sterilization which is produced during that period, the number of protozoa definitely remains constant. A change in condition however was experienced indicated by a decrease in activity.

The reclamation of soils containing chloride and carbonate of sodium was also the object of researches on the part of the writer.

It is known that this reclamation is at the present time based on the cultivation of rice, which is a summer crop and as such does not fully benefit by flood water.

The writer tried whether it was possible to eliminate the rice crop in order to save the water which is absorbed and to utilize that water, at flood, at a time when most was available, for washing the soil. The experiments made have shown that the elimination of chloride of sodium by simple washings is arrested at a given moment, that a hydrolysis of the sodium-clay complex, a deflocculation of the colloids is then produced ; the water no longer runs off in the drains and the soil becomes alkaline.

The growth of rice prevents these drawback. The rice is sown precisely,

in the course of the process of freeing the soil from salt, at the moment when, after preliminary washings, the hydrolysis of the sodium-clay complex begins to take place. The roots establish themselves in the surface layer of the soil; they generate carbon dioxide in sufficient quantity to transform the sodium hydrate formed by the process of hydrolysis, first of all into carbonate and then into bi-carbonate of sodium. This latter substance, not being alkaline, prevents the deflocculation of the soil colloids and hence the soil remains permeable. The successful growth of rice therefore plays a capital part in the reclamation of the soil. Unfortunately a successful rice crop cannot be guaranteed. Accordingly the writer has tried whether it is possible to do without it and to devise a method whereby the sodium clay complex might be hydrolysed and the alkaline products of this hydrolysis, due to the action of continuous washing of the soil, removed. Experiments to date point to the possible use of sodium bisulphate.

On the Effect of Drainage on the Physical Condition and the Mechanical Construction of Soil.

JANOTA RUDOLF, O účinku drenazé na fysikalni stov a mechanickon stavbu půdy. Sborník výzkumnych ústavů zemědělskych, sv. 16. *Ministerstvo zemedelstvi*. Prague, 1925.

The investigations on the effect of drainage on the physical condition and the mechanical composition of soil were carried out by the Pedological Section of the Technical Bureau of the Bohemian Land Cultivation Board, in the years 1920-1924, in the loamy and heavy soils of N. E. Bohemia, in the districts where these soils are for the most part drained. The soil investigated consisted of light Podsol brown earths, or heavy Cretaceous soils with an underlying layer of marl. Nineteen cases were considered in drained, and nine in undrained situations. With regard to the mechanical construction and physical condition, 90 soil profiles were examined in all, mostly to a depth of over 1.0 m., by 414 physical and 407 mechanical analyses.

For the investigation a combination of KOPECKY's physical and mechanical analysis was used, and samples of soil which were always taken from several depths of the same sounding in the natural bed. On the drained situations the soundings were chosen at different distances from the drain, mostly at 1.0 m. or 3.0 m. distance, in between the drains. The results of the mechanical analyses, together with the determination of the carbonate of lime, are compared in tables.

From the results of the investigation the following statement can be made: —

Where drainage had been carried out, a free underground water-level up to the depth of the drainage was not noticeable in any of the situations under observation, and its formation in the soundings between the drains could not be followed up. By drainage a quick removal of the excessive moisture of the soil is effected, and the firmly bedded soils are changed by drainage from a humid to a dry condition. The distri-

bution of moisture in drained soils can be determined by the physical analysis, and the effect of the percolation of water through the soil in respect to the formation of individual levels can be checked by mechanical analysis.

The formation of the type of soil follows as a function of the percolation of water through the soil, and is therefore of great importance in cultivation technics. By reduction of the contents of electrolytes, fine soil substances are released in the upper (elluvial) layers, and deposited at the depth to which the penetration of the percolating atmospheric water as a rule reaches (illuvial level). The impoverishment of the upper layers and the enrichment of the subsoil can be followed in the results of the mechanical analyses.

In the cases given, in loamy soils the difference in content of the fine constituents, which can be washed out, of the arable crust and the illuvial layer goes up to 10 %, and in heavy soils up to 20 %, according to composition.

The process of the formation of Podsol soils also arises from the washing out of the carbonate of lime from the elluvial levels A,A1 and its deposit in the illuvial level B.

For measuring the amount of drainage, the investigation and characterization of the red-brown illuvial level B1, which in the cases in question usually shows itself at a depth of 0.75-1.0 m., is of the greatest importance. It is expressed by the greatest content of fine constituents which can be washed out in the soil profile concerned, by a high carbonate of lime content, by notable enrichment by iron compounds, by the smallest pore-volume and consequently the worst structure and lowest absolute air capacity which in technical practice influences conditions of permeability.

According to the investigations carried out, the illuvial level (B) signifies practically the limit for the penetration of atmospheric deposits, the lower limit of the changing of the physical condition of the soil during the time of vegetation, and therefore probably also of the total activity of the soil in a chemical and biological respect. From the technical cultural standpoint it denotes the most impermeable layer in the soil profile concerned, on to which oozes the water containing the precipitates, whose five constituents are redeposited, causing thereby a continual closing of the pores of the soil.

In loamy soils the illuvial level still remains fairly permeable; in heavy soils the absolute air capacity sinks to below 0.5 % of the volume, causing this layer to become inaccessible to the penetration of water, air, and consequently also roots.

The moisture condition, during the time of vegetation, undergoes considerable alterations in the alluvial levels only, whilst the deeper layers show a similar condition of moisture in the spring and autumn. In loamy situations the momentary condition of the humidity is lower in spring than the absolute water capacity, and the humidity is evenly distributed in all layers. In heavy soils the upper layers are usually saturated in spring to the absolute water capacity, sometimes beyond

in which case the elluvial layers often become marshy. The deeper layers below the illuvial level at the same time show a lower degree of humidity, because the influence of the atmospheric deposits does not reach to this depth.

The aeration expressed by the momentary air-content is greatest in the elluvial layers, falling gradually until reaching the illuvial level, below which no notable alterations in air-content take place. The aeration is greater in autumn than in spring. The above differences are greater in loamy soils, and consequently these soils are also more active than the heavy soils. In the latter the greater aeration of the upper layers is caused by intensive drying and the falling out of colloidal substances. The crumbly structure attained in this way, however, is in an unstable state, and its maintenance must be supported by surface drainage.

From fairly numerous results of the investigation of the places brought under observation, it appears, however, that the infiltration of the water, and the concentration of the percolation through the soil in the direction towards the drain, after a long time also exerts a notable influence on the lixiviation process, which is especially important in heavy soils. The effect of drainage on the metamorphosis of the type of soil of the drained situations is shown in the following manner:

In the upper layers the content of fine constituent parts capable of being washed out and of the carbonates increases from the drain towards the central point between the drains. At the same time the pore volume sinks with the increasing distance from the drain. From this it can be concluded that the elluvial layers are cleansed most by the drain, and so they show the best structure.

In the illuvial layer, on the other hand, the content of fine constituent parts capable of being washed out, and of carbonates, is greatest near the drain, where also the pore volume is smallest; towards the middle between the drains the content of fine constituent parts and carbonates is less, and the porosity greater. The illuvial level, as a result of the deposit of the fine substances near the drain, possesses the worst structure, and is most impermeable, which is very important particularly in heavy soils.

By the influence of the drainage the physical condition of the soil undergoes rapid alterations, especially in the upper layer, with diminishing tendency as the depth increases, and in such a manner that in the illuvial level these alterations, particularly with heavy kinds of soil, almost disappear.

For the percolation of the water through the soil, the composition and structure of the soil in the illuvial level B is decisive; for the valuation and characterization of the conditions of the soil for drainage purposes, the samples of soil concerned must be taken from this level for analysis.

As the illuvial level B in loamy soils is fairly permeable, in such soils a deeper drainage (up to 1.40 m., max. 1.50) can be chosen, in order to force the percolation of the water to the drain through a stronger layer of soil. The humidity distributed in this manner through a greater

layer of soil, with corresponding capillary attraction, gradually becomes of value at a time of dryness.

In heavy soils the unfavourable condition is caused by the precipitated water, scanty aeration and high water capacity as a result of a superfluity of colloidal substances. The improvement of the structure of the heavy soil can be effected by the elimination of the colloidal constituent parts, by quick removal of the humidity, or by intensive drying. For this purpose, in these soils, superficial drainage (about 1.0 m. deep) is better, stopping at the illuvial level, and connecting directly with the elluvial layers, from which it quickly drains off the water. By this means, the washing out of the colloidal constituents by the drainage water in the upper layers is assisted, and so its coherence and excessive water capacity are reduced. In heavy soils the illuvial level represents the natural depth of the drainage, as it separates almost completely the elluvial layers from the deeper ones. Under our climatic conditions the influence of frost does not reach the depth of the superficial drainage, and moreover, this never conducts water in the full profile in winter, so that the pipes cannot be injured by freezing.

The achieving and maintaining of the crumbly structure is much more difficult in heavy than in loamy kinds of soil. In these situations, after carrying out the drainage, liming is advisable in order to get a coarser structure; for this purpose, in marly situations, the deposit from the deeper layers can be advantageously used, whereby the carbonate of lime originally washed out can be partially given back to the upper layers. In laying drains in heavy soils, it is better to cover the drain with soil from the upper elluvial layers, in which there is a lower content of fine parts that can be washed out, and which are therefore more permeable.

L. SMOLIK.

Experiments in Sub-irrigation.

ROSSI E. *Nuovi Annali dell'Agricoltura del Ministero dell'Economia Nazionale*, p. 25 to 50, year V, No. 1-2. Rome, 1925. Provveditorato Generale dello Stato, Libreria.

An irrigation system in which the water rises from the subsoil to the roots, that is to say sub-irrigation or subterraneous irrigation, appears more rational than the application of water at the surface of the ground or the usual irrigation. Sub-irrigation should imitate what happens in semi-arid countries during the dry season, in which care is taken by suitable cultivation to keep the surface of the soil thoroughly friable and broken up, however dry, while the moisture is allowed to replenish the roots from the reserve in the sub-soil by means of the natural capillary action.

Conceived in this way the chief aim of sub-irrigation should be to reduce the loss of moisture by evaporation from the surface of the soil, a very important object when little water is available.

Attempts at sub-irrigation are not lacking, especially in America; but apparently it is only at Sanford in Florida that sub-irrigation has given better results than surface irrigation; elsewhere it has generally been abandoned.

At the present time three systems of sub-irrigation are known :—

1. LEE's system suggested for orchards. A subterranean system of iron pipes, composed of a main pipe of 15 cm. and lateral ramifications of 7.5 cm. is arranged running along the rows of trees and has an aperture which can be opened or closed from outside corresponding with each tree.

2. The SANFORD-MONTERISI system consists in placing, at a depth of 40-45 cm., a series of earthenware pipes 20-25 cm long, and 80 mm. in diameter inserted in each other in such a way that the water escapes freely at the junctions. These pipes branch out from a closed main system of piping situated in the highest part of the field. The distance between the lines of underground irrigating pipes is 5.40-7.20 m.

3. Systems o *porous pipes*. ULPIANI proposed to make use of very porous earthenware pipes cemented one to another so as to form a perfectly closed system which could be immediately filled with water. The water exudes slowly through the pores of the earthenware and is absorbed by the soil with the greater avidity, the drier the soil.

The MONTERISI system was adopted on the farm of the Station near Bari, selecting a plot of ground which at a depth varying from 50 cm. to 1 m. presented a slight formation of crust, very friable however and probably not continuous. The water under pressure coming from the Apulian aqueduct was introduced by means of a flexible connection directly into the head of the subterranean system of pipes, after having passed through a Meinecke meter.

For experimental purposes the lines of pipes were placed at various distances between 2.50 m. and 5 m. and at depths of 40 cm. and 50 cm. For comparison with the sub-irrigation, surface irrigation with the furrow method, that is to say by infiltration, was practised in plots adjacent to those sub-irrigated. The soil is reddish alluvial sandy-loam, rather friable.

The porosity was determined at the beginning of the experiments and at the end, namely in September ; in the unirrigated plot, which was kept carefully hoed, the caking of the soil was nil at the surface and negligible at a depth ; in the sub-irrigated plot it was nil at the surface, slight at a depth ; in the surface irrigated plot it was high at the surface, considerable at a depth.

Diffusion of the water around the system of piping.

Vertical diffusion from the system of piping to the surface. — In one hour and a half (capillary ascension measured in Wahenschaffe's tube) the water ascended 25 cm., in eight hours it already reached 40 cm. After which the ascension took place more and more slowly, though despite this after 36 hours 50 cm. was passed. In the soil, directly after the water had been administered the following degrees of moisture were recorded :—

	4th row (50 cm.)	5th row (40 cm.)
In contact with the pipes	20.00-21.22 %	20.75-22.3 %
10 cm. above	17.13-19.50 »	20.00-21.13 »
20 » »	15.05-18.35 »	18.52-19.25 »
30 » »	12.45-15.20 »	16.70-18.42 »
40 » »	9.50-10.15 »	— — »

The higher figures were recorded within 20 metres of the inlet, the lower figures in the 20 metres further away.

At 10 metres distance fr m the system of piping, where certainly its influence could not reach, there was, at a depth of 40 cm., a degree of humidity, slightly less than that at the surface of the sub-irrigated ground.

Lateral diffusion. — In 1924 after 1-7-14-21 days from the third sub-irrigation, the humidity, at 1 m. from the pipe, at 20 cm. depth, gradually decreased from 13.35 % to 8.00 % ; at 40 cm. depth, from 13.60 % to 8.50 % ; at 2 metres from the pipe at 20 cm. depth from 12.30 % to 7.02 % ; at 40 cm. from 13.18 % to 8.45 %. At 4 metres distance from the pipe the humidity scarcely exceeded 10 % in the first 24 hours, at 6 metres it remained much below this. At 8 metres distance the effect of the sub-irrigation was not felt. At 4 metres, 7 days after the watering, the humidity had already decreased to below 10 % ; at 2 metres after 14 days, at 1 metre after 3 weeks.

Diffusion between the systems of piping. — In 1923, in which the reserve water in the soil was greater, after the sub-irrigation in July a degree of humidity in excess of 15 % was maintained for over 14 days, even between the systems of piping 5 metres apart. After the sub-irrigation in August however, the humidity after 7 days had already decreased below 10 % between the systems of piping 5 metres apart and after 14 days between the two rows 2.50 m. apart.

In 1924, after the 3rd sub-irrigation given at the end of July, at 20 cm. depth, 15 % of humidity was attained and maintained for some days only between systems of piping 2.50 and 3 metres apart, 10 % was maintained for 7 days also at a distance of 5 metres, for 14 days at 3 metres, for 2 days at 2.50 metres.

At a depth of 40 cm. 15 % of humidity was reached and maintained for 14 days between systems of piping 2.5 m. apart, for 7 days between pipes 3 and 4 m. apart, for a few days between pipes 5 m. apart. 11.10% of humidity was maintained for 21 days at 2.50 and 3 m., for 14 days at 4 and 5 m. distance between the pipes ; however at 4 m. distance after 21 days 9.90 % of humidity was still found at a depth of 40 cm.

Such records, made in the hottest and driest season and repeated every time at various points at different distances from the inlet, permit of the conclusion that in our installation a distance of 4 m. between the system of piping may be adopted even for a rotation of 3 weeks, while a distance of 5 m. requires a rotation of 2 weeks, if it is desired to maintain, at least at 40 cm. depth, a humidity of 10 %, the minimum necessary for the growth of herbaceous plants.

Diffusion below. — Much more water penetrates and is maintained below the systems of piping than above them. Part of this reserve rises by capillarity, but substantially this system of sub-irrigation tends, in soils of our type, to enrich the subsoil with water at a depth to which it is certain that the roots of common summer grown plants do not reach.

Diffusion according to the initial humidity — The moister the soil is before the application, the greater is the humidity

obtained by the same quantity of water and the longer is it maintained. Therefore it is better to begin sub-irrigation in spring, when the soil still has a greater humidity than 10 %, and not to wait until the humidity falls below that percentage. The reserve of humidity in the subsoil also influences the rapidity with which the water runs through the sub-irrigating system of piping. As summer advances the drying is more rapid after each application.

In the tests in 1923 a total of 4493 cubic m. of water was required per hectare ; in 1924 even more was required. Such a high consumption must be caused, in addition to that by ordinary evaporation (even with sub-irrigation there is loss of water by ordinary evaporation) and by the very strong transpiration of the plants in summer months, by the dispersion of water, in the subsoil, as in fact there have been means of recording.

The water's rate of progress is rapid in the immediate vicinity of the inlet, then progressively slower until it requires a very long time to get through the last metres. This is obviously due to the progressive decrease in the power of flow. To obviate this drawback I experimented with longer pipes of 70 and 95 cm. in 1924 in a new installation. These preliminary experiments prove that, at least in our conditions of soil, time and water are saved by using pipes of various length, placing the longest at the inlet and then gradually the shorter. For the installation of a field of sub-irrigation, according as use is made of pipes of various lengths or of pipes all 25 cm. long, an expenditure of 9200 to 10 000 lire It. per hectare has to be met. At 9200 lire, counting on a duration of 10 years there would be an annual cost of amortization and interest of L. 1380.

For surface irrigation, calculating a maximum of 15 irrigations from the 1st May to the 30th September, which really in this climate should not ever be necessary, the cost of labour does not exceed 800 lires. The factor therefore which would make sub-irrigation preferable to surface irrigation is the consumption of water.

Principal conclusions.

Surface irrigation causes the soil to cake strongly at the surface, considerably at a depth ; sub-irrigation slightly at a depth, not at all on the surface. A few hours suffice to cause the moisture from underground pipes to rise to the surface. A depth of 50 cm. is to be preferred, because pipes at 40 cm. keep the surface moister, thus favouring evaporation and the development of surface weeds. Laterally to the pipe however humidity is maintained longer at a depth and favours the development of plants with tap roots and bulbs, including some weeds which cannot be got rid of by hoeing. The distance between the system of pipes should not exceed 5 metres ; at 8 metres there would be no effect.

With the system of open junctions (SANFORD-MONTERISI), experimented with by us, most of the water is lost in the subsoil, if the latter is permeable, and is not utilised by surface rooted plants. This leads to a waste of water, which however, decreases at every successive irrigation. It is best to make use of pipes of different lengths to render the escape of water at each junction constant, with great saving of time and water.

Among the plants experimented with, maize, beans, tomatoes and cotton produced more with surface than sub-irrigation, while soy-bean, lentil, sorghum, sesame, *Vigna sinensis* (forage) produced more with sub-irrigation.

With regard to dry cultivation, the increased production obtained with sub-irrigation pays for the cost of the installation and consumption of water for plants which grow all the summer, while for early produce and for some varieties of soy-bean the advantage depends on the course of the season. Super-irrigation costs less including labour and water than sub-irrigation with the MONTERISI system, but I abstain from a final judgement, having worked in soil conditions unfavourable to this system.

THE AUTHOR.

Tests of Surface Tillage for Maintaining Humidity in the Soil.

ROSSI, E. Agricultural Experimental Station of Bari, No. 6, pp. 27, and 1 diagram, April 1926.

Various experiments carried out by eminent agriculturists have demonstrated the utility of surface tillage for maintaining existing humidity in the soil. The tests therefore, dealt with in the above noted account, were made with the aim of determining the importance of the phenomenon itself, working under quite special conditions of soil and climate (Southern Italy), rather than to demonstrate the fact now long established. The enquiry was further extended to the greater or less influence which surface loosening of the soil (2-3 cm.) and working it to a certain depth (12-15 cm.), might have on the question. Results were obtained on ground which was planted with vines, one part of which was prepared after the manner of the district, with furrows designed to get a large collection of water during the spring rains along the rows of vines, planted precisely at the bottom of the furrow. The humidity was determined at different depths by taking always for each plot of the 4 types :— (unworked — surface loosened — worked to about 15 cm. — with furrows) two samples at the same point, the first at about 20 cm. depth the second at about 40 cm. depth.

The soil which was the subject of the experiment is a soil derived from the decomposition of the so-called "calcareous tufas" belonging to the Pliocene or Post-pliocene formations. These are sandy calcareous rocks, more or less coherent and containing scattered fragments of mollusc, echinoderms, foraminifera, corals and other more or less macroscopic marine fossils. After Cretaceous they are the most common soils in Apulia.

The experiment, was started on the 14th March, and finished on the 30th August.

In the course of the experiment fully 20 observations were made.

The best result was given by the plot loosened at the surface and by the plot arranged in furrows, which after the initial preparation of the soil on the 14th March, was worked again to relevel the surface on the 16th May; the other two plots were loosened on the 17th April, the 16th May and

the 23rd June; on this latter date the surface of the fourth plot, which, as noted above, was kept in furrows up to the 16th May, was slightly loosened. The minima percentages of humidity (mean of the humidity of the soil) in a thickness of 10 cm at a depth of about 40 cm. occurred :—

In the unworked plot	on the 1st August :—	3.085 %
In the plot loosened at the surface	on the 10th August :—	5.025 %
In the plot loosened to a depth of 15 cm	on the 10th August :—	5.45 %
In the plot arranged in furrows .	on the 23rd July :—	5.625 %

The maximum difference between the humidity of the loosened plots and the unworked plot was recorded :—

for the plot loosened at the surface, on the 7th May :—	4.90 %
for the plot loosened to a depth of 15 cm. about the 7th May :—	3.75 %
for the plot arranged in furrows on the 16th May :— .	3.79 %

On the days in which the maxima differences of humidity were registered there remained in the plot loosened at the surface and in the plot arranged in furrows a quantity of water double that remaining in the unworked plot, and not much less than the quantity of water which remained in the plot loosened to a depth of about 15 cm.

The humidity fell below 6 % twice in the plot loosened at the surface; once in the plot arranged in furrows; fully 6 times in the plot loosened to a depth of about 15 cm; while in the unworked plot, from the 16th May to the 20th August, or for fully 11 observations, the humidity almost always varied between 3 % and 4.95 %.

It is a noteworthy fact that on the arrival of the dry period, the surface of the unworked plot became more and more compact, until a pan 5-6 cm thick was formed, so hard that it required great effort to break it every time that samples were taken. Below this pan the soil continued to remain very loose and the water contained in the soil, owing to its intimate and uninterrupted contact with the hard stratum over its whole surface, had been able to go on evaporating until the humidity was reduced to such a minimum, as is seldom reached in soils of sub-humid regions and only very exceptionally in those of humid regions.

Contribution to the Mechanical Analysis of the Soil.

SEIWERTH, A. Prilozi mehanickoj analizi Ha. Glasnik za Lumske pokuse I. 1926. Zagreb.

The writer gives some results of comparative analyses of soils carried out by means of ATTERBERG's and KOPECKY's apparatus using distilled water and aqueduct water of the town of Zagreb.

In table 1 are found the results for soil particles having a diameter of less than 0.002 mm. of parallel analyses made at the same time with

distilled water and acqueduct water in ATTERBERG's apparatus. The figure shows the parallel test of sedimentation of a loam in distilled water and aqueduct water. After 24 hours of sedimentation, for 20 cm. of height, the soil in the aqueduct water is almost entirely found at the bottom. The liquid was so clear that the dark line behind the apparatus could be seen. On the other hand suspension in distilled water remains so dense that the dark line behind the apparatus could not be seen through the liquid.

In Table 2 are set o: t the quantitative differences found in the different samples of soils by washing them with distilled water and aqueduct water in KOPECKY's apparatus. The parallel analyses were made with each sample of soil always in the same apparatus. In the same table it is seen that the small differences in temperature for the same soil in the same water are without perceptible influence on the results of the analyses.

Table 3 shows that even slightly greater differences of temperature have not had any greater influence.

From the heading " duration of washing " of table 2 it is seen that the time required to carry out an analysis varies very much according to the samples, but it is generally shorter in distilled water than in aqueduct water. For sample K, table 4 shows the influence of the too hasty stoppage of washing on the results of a mechanical analysis.

For the cylinders of KOPECKY's apparatus the time in which one litre of water runs off is 201.03″ and not 202″ as is found in books. But it is seen from table 5 that this small difference in the time of running off has no influence on the results of analyses. In the same table are found the results obtained by washing soil or quartz sand when the time of running off is 202″ or 200″.

L. SMOLIK.

Effect of Mulches on Soil Temperatures, during Warmest Week in July 1925 at Davis, California.

SMITH, Ph. D. sen. University of California, Davis.

The highest soil temperature found was in the bare plot, where on July 17, 1925 at a depth of one-half inch the electrical resistance thermometer registered 143 degree Fahrenheit. Temperatures were obtained at a depth of one-half inch in only two plots and the results showed that in the bare plot it was 10 degrees warmer during the day on the average and 5.6 degrees cooler at night than on the plot covered with perforated black paper. In these same two plots temperatures were obtained at the six inch depth. In the bare plot the average day temperature at 6" depth for the week was 0.9 degrees higher and the average night temperature was 0.6 degrees higher than on the area covered with perforated black mulch paper.

In the bare plot where temperatures were obtained at depths of ½, 3, 6, 12, 24 and 36 inches, decided differences were found between the day and night temperatures down to a depth of 12 inches.

Where a black paper, mulch paper non-perforated, was used, the average temperature for this warm week at a depth of 3 inches was 97 degrees

as compared to 91.1 on the bare plot. The next warmest plot was that covered with perforated black paper where it was 90.9, followed the gray paper non-perforated plot with 87, and finally the gray paper perforated with 85.7 degrees

The maximum temperatures at the 3 inch depth occurred usually about the same time which was two hours after the maximum air temperature was reached. The range in these soil maxima was 13 degrees at the 3 inch depth.

The minimum temperatures at the 3 inch depth occurred on the average 1 hour and 40 minutes after the minimum air temperature and showed a range of 7.4 degrees.

Temperatures taken at the 12 inch depth showed that under the black non-perforated paper it was on the average 5.5 degrees and under the perforated black paper one degree warmer than in the bare plot during the day, while under the gray non-perforated paper it was 3.6 degrees colder and under the gray perforated it was 4.9 degrees colder than in the bare plot.

The average night temperatures at the 12 inch depth were highest under the black non perforated paper and lowest under the gray perforated paper.

The maximum temperatures at the 12 inch depth occurred usually at about the same time, which was 8 hours after the maximum air temperature was reached, and showed a range in the various plots of 11.6 degrees. The minimum temperatures at the same depth occurred on the average 6 hours after the minimum air temperatures and showed a range of 10.6 degrees.

The colour of the soil surface or the colour of the paper mulch and whether the paper is perforated or not produce a marked effect on soil temperatures.

The warmest soil during this week was that covered with non-perforated black paper and the coldest was that covered with the gray perforated paper. X.

The Application of Archimedes' Law to the Mechanical Analysis of Soil.

SMOLIK J. Využití Archimedova zákona při mechanickém rozboru půd. *Zemědělskv Archiv.* Prague, 1925.

Archimedes' law can be applied with advantage for the simplification and shortening of the practical mechanical analysis of mineral soils according to KOPECKY.

For this purpose the various particles, after being separated into their size categories, are transferred from the cleansing cylinders into weighed Erlenmeyer flasks (the various sizes of flasks 1 ½ litres 500 ccm., 300 ccm., serve very well) which are fill d with water and then weighed. The net weight of each category in the water is multiplied by 1.6, and so the weight in the air is obtained.

If it is a question of percentual data, then the net weight in the water is multiplied by 3, when 53.33 g. of soil are taken for the analysis, or by 3.2 if 50 g. of the soil are taken. VERF.

Soil Chemistry.

The Use of the Quinhydron Electrode for Measuring the Hydrogen-Ion Concentration of Soils.

BAVER, L. D. (Ohio Agr. Exp. Station), *Soil Science*, Vol. XXI, pp. 167-179. Baltimore, Md., 1926.

A study of the quinhydrone method for determining the hydrogen-ion concentration of soils leads to the following conclusions :

1. The saturated calomel cell is the most convenient to use since it is most constant and does not require a reversal of poles below pH 7.68.

2. For accurate results 0.05 gm. of quinhydrone per 15 cc. of solution is sufficient. The quinhydrone may be added in solution provided a fresh stock is prepared each day.

3. The potential is very constant with this electrode with the exception of soils above pH 8.0. It is reached quickly and easily.

4. The quinhydron and ordinary hydrogen electrodes compare closely. Variations were obtained from 0 to 0.2 in pH, which is considered close enough for most soils work.

5. The most desirable soil-water ratio to use as a standard with the quinhydrone electrode is the ratio of 1 : 1. It gives results comparing closely with those obtained with the ordinary hydrogen electrode.

The quinhydrone method has a very distinct advantage over the ordinary hydrogen electrode inasmuch as the apparatus required is simpler, both in construction and operation, and requires a much shorter time to reach equilibrium. The method is applicable to field as well as laboratory purposes. J. S. JOFFE.

On the Degree of Resistance of various Limestones to Acid Solutions circulating in Agricultural Soil.

BOTTINI, E. (Torino S. Stazione Chimico-agraria). *Le Stazioni sperimentali Agrarie Italiane*, Vol. 52, No. 7-9, pp. 268-288. Modena, 1926.

A large number of products are called limestones which, while having allied chemical compositions, are very different in structure and physical properties ; this diversity of structure evidently entails a different degree of resistance to physical and chemical agents, and hence a different behaviour of the various, types of limestone towards agricultural soil and the roots of plants. The researches made by the writer admit of the following conclusions :—

1) Limestones as regards their behaviour towards acid liquids (aqueous solution of CO_2), 1 % aqueous solution of acetic acid, 5 % acetic acid, N/10 hydrochloric acid, and N/10 nitric acid), may be divided into three groups. The first group includes the marly, concretionary, sandy and fos-

siliferous limestones, which are those most easily decomposed. The second group includes the argillaceous limestones which are more resistant than the previous kinds. Lastly, the third group includes dolomitic, saccharoid and compact limestones which are those least easily decomposed.

2) The decomposition of limestones follows fairly closely their respective specific weights, the smaller the specific weight, the more easy the decomposition. Exceptions are in the first group, the concretionary limestones and, in the third group, the dolomitic limestones. For these latter, however, the anomaly is easily explained by their peculiar composition.

3) The degree of resistance of limestones varies with their geological disposition, limestones belonging to the deepest strata of the ground being less easily decomposed than those belonging to more recent strata.

4) It is thus clearly proved that in soil investigations not only should the content in $CaCO_3$ be taken into account, but also its behaviour towards decomposition which varies according to the nature of the soil itself.

Contribution to the Explanation of the Effect of Colloidal Silicic Acid in increasing Production in Sandy Cultivations.

Duchon, F. *Zeitschrift für Pflänzenernährung und Düngung.* Part A, 4th Year, Vol. 5.

The favourable effect of colloidal silicic acid on productivity where there is insufficient phosphoric acid manuring in sandy cultivations rests mainly on the physical qualities of the colloids, which improve the physically unfavourable conditions of the sand. The physical improvement then shows itself in a better utilization of the apparently small but actually sufficiently large additions of phosphoric acid. The natural soils contain, with suitable tillage, sufficient indeed abundant quantities of colloids. Sterile sands, poor in colloid substances, of similar character to the sand used in pot cultures can be improved in practice by stable manure or green manure, which has therefore been introduced and proved in practice. By this means the production factors of the food material supplied in the form of artificial manures is increased at least in the same measure as by the use of colloidal silicic acid in pot cultures. And so the use of colloidal silicic acid has no importance in practice. Just as the established suitability of the Na in pot cultures to take the place of K to a certain degree has no significance, so colloidal silicic acid as a means of saving phosphoric acid is also of no importance. The means by which one can be assured of the highest production factor of the phosphoric acid manure, are to cover the natural soils with those which in practice increase the fermentation processes of the soil. Such being the case then, if we want big agricultural harvests, it will not be possible to replace full manuring which contains the indispensable phosphoric acid manure, in other words we must use easily soluble phosphates.

L. Smolik.

On the position of the Practical Agriculturist to the Question of the Acidity of the Soil.

EINECKE A. *Illustr. Landw. Ztg.* Year. 45, No. 28, p. 339. 1925.

The author warns against the under estimation of the importance of the question of soil acidity for the condition of the soil and the health of plants. The comprehension of the " condit.on of the s il " first emphasized by HUNIG, appears to be of special importance for guarding against acid and alkaline injuries. For example we know that a mineral soil which is rich in fine earth, humus and lime in a finely distributed condition, and possesses normal water characteristics, shows a strong " digestive capacity " for all manuring materials, and so an exact knowledge of the contents of fine earth, humus and lime in the soils of a farm is of the greatest importance to the practical agriculturist.

He also points out the importance of the fact that by using physiologically acid manuring material on soils which are already acid great damage to plants may easily occur, therefore a proper consideration by the agriculturist of the questions pertaining to liming in exact amounts is essential, . nd the suitable application of physiologically alkaline, neutral or acid manuring materials must be striven for. He gives warning against the agriculturist relying on the results of his own investigations with the various " acidity testers " etc. K. SCHARRER.

Studies on the Influence of Lime on the Soil.

GEHRING, A. and WEHRMANN, O. *Landw. Versuchsstat.*, 103, 279, 1925.

Taking the speed of nitrate formation as a measure of the influence of lime on the soil, we got the following results :— quick-lime, marl, " without manure ", lime of potassium and residual lime. The influence of the residual lime on the physical condition of the soil shewed no better results than those of normal lime manuring, while biologically it was distinctly injurious. Certain associations exist between physical quality on the one side and CO_2 production and nitrification on the other Only the residual lime and the lime of potassium do not obey this law ; the first named material, in a mechanical respect, produces nearly as great an effect as quick-lime, but as regards CO_2 production and nitrate formation it remains far behind the unmanured plot, evidently because of its high content of chlorides, which have a disinfecting effect. On account of its high potash contents the lime of potassium shows an inclination to cause coagulation. As regards the breaking up of the organic matters in the soil effected by manuring with the various kinds of lime, it appears that, measured by the quantity of CO_2 produced, quick-lime has the best effect, followed by residual lime, marl and lime of potassium. D. MAYER and HISSINK have mentioned processes for separating absorptive combined lime from that soluble in acid. The former works with a 10 % NH_4Cl solution, the latter with N/1 NaCl solution. Comparative experiments of the authors induced them to work in accordance with the more detailed but more exact methods of HISSINK. They

also give an account of a theory of method for determining the highest combination capacity of lime, and, in conjunction with the process of HISSINK, the so-called *lime saturation factor*; 25 g. of the same soil has 40 ccm. saturated quick-lime solution poured over it, and is then shaken for 30 minutes. A few drops of phenolphtalein are then added, and CO_2 is introduced until colour appears. The CO_2 lying over the liquid is removed by introducing air, while that in solution in the liquid is removed by heating for a short time to 60° and by blowing air through. A further 20 ccm. of the saturated quick-lime solution is allowed to run in, it is shaken for 30 minutes, CO_2 again introduced, and this process is repeated until the desired quantity of liquid, 100 ccm., is reached. After the last saturation of the remaining lime with CO_2, as much solid sodium chloride is added to the quantity of liquid as is necessary to make the solution normal. It is then heated to 80-90°, allowed to stand for 12 hours, and the exchangeable lime is determined by separating the absorbed lime from the carbonate in the manner suggested by HISSINK. The quotient, determined according to HISSINK, of the available contents of absorbed lime and the maximum content, determined by the authors' methods, gives the degree of saturation of the soil. At a saturation degree of 70 the requirement of lime of the soils examined ceases. With soils having a degree of saturation of 70-72, the authors could not obtain increased crops by applying more lime. There consequently appears to be a parallelism between the degree of saturation and increased production. It further appeared that if no hydrolytic acidity occurs in a soil, there is also no necessity for lime; in such cases, therefore, it is superfluous to carry out the methods of determining the degree of saturation.

K. SCHARRER.

Critical Investigations on Neubauer's Seedling Method.

GUENTHER, E. *Zeitschrift f. Pflanzenernährung und Düngung*. Vol. V, Sect. I, Part B, 1926.

The author examines the influence of light and of the soil reaction on assimilation of foodstuffs by seedlings. The analysis figures of the same soils under different light conditions during growth show that the influence of light plays a subordinate part, and under normal conditions can be entirely neglected. With a soil in which, having otherwise the same contents of food materials different degrees of acidity were produced by the addition of calcium carbonate, it is clear from the results of the analysis that the difference of soil reaction does not affect the food assimilation by seedlings, unless it is very marked.

L. G.

Taking Samples of Soil from the Field.

HAEHNE, H. *Zeitschrift für Pflanzenernährung und Düngung* Vol. V, Sect. I. Part B. 1926.

Mixed samples, which came from a different number of places distributed uniformly over the field under investigation, were examined by

NEUBAUER's seedling method and the results compared, in order to be able to work out a definite rule for taking samples of soil from the field. It appeared that an average sample from 10-15 places in fields which can be described as uniform is quite sufficient, whilst if taken from only 5 places, the probability of finding the correct a, erage is too s..all. The a erage of the samples anc not any individual one must be using for judging the field. GOERNER.

Nitrification Studies.

HALVERSEN W. V. Oregon Agricultural Experiment Station, Cornwallis.

Nitrification tests were run on a series of fertiliser plots to determine the relative value of several methods. These plots are located on Willamette silty clay loam, which is a prominent soil type of the Willamette Valley. It normally has a pH value of about 5.5 and is one of the most fertile soils in that locality. In these tests the power of the various soils to produce nitrates from their own organic matter, from 30 mgs. of N as ammonium sulphate, from the same amount of ammonia sulphate added with 210 mgs. of $CaCO_3$ and also from 0.1 % of blood meal were determined. In all cases 100 gms. soil were used at optimum moisture content. The nitrate production in the soil itself was so small during the 28 days incubation period as to give little information : the other methods gave parallel results except on one plot which received heavy applications of sulphur, superphosphate and potassium sulphate, in which case the blood meal gave comparatively higher yields of nitrate. It is significant that on plots which had received excessive applications of lime in the field, the yield of nitrates was proportionately higher in the tests where the $CaCO_3$, was added with the ammonium sulphate. Over this wide range of acidity and fertiliser treatment the merits of one method over another were not apparent, though a range of H ion concentration from 5.2 to 7.2 and a wide variation in buffer content prevailed.

The nitrate content of fallow plots adjacent to the fertiliser plots which had received 0, 2, 4, and 6 tons of lime respectively per acre was determined at several intervals during the growing season, and showed that lime promotes the production of nitrates in this type of soil. The most nitrate is found where the largest application of lime is made, even though that application is excessive. The production of nitrates in the soil is in agreement with the laboratory tests and is quite necessary and should be taken in consideration in determining the nitrifying power of a soil. Numerous analyses, however, of soils on which crops are growing fail to yield more than a trace of nitrates until the crop is harvested.

That a difference in the physiological efficiency of the nitrifying flora of soils exists is shown by the parallel results obtained when nitrification tests are run in both soil and solutions. However, the fact that nitrification is more dependent on the soil conditions than the biological efficiency is evidenced by the failure of soils to produce larger quantities of nitrates after being inoculated with a soil infusion containing organisms of a higher physiological efficiency. X.

On the Retension of Superphosphates in Acid Soils.

KAPPEN, H. *Deutsche landw. Presse*, 52, 489 and 496, 1925.

On the basis of his experiments, the author comes to the opinion that the fear that superphosphate-phosphoric acid can form such compounds in the free acid soil as to check the plants, or at least have less effect than on other soils, is unfounded. His vegetation and chemical solution tests showed that the presence of excessive Al- and Fe- sesquioxide did not have any ill effect on the absorption of the Al- and Fe- phosphates as both of these are easily assimilated by plants. K. SCHARRER.

The Recovery Power of a Soil as indicated by Incubation.

MARTIN, F. C. Laboratory of Plant Nutrition, University of California. Berkeley, California, 1926.

A brief review of the characteristic behaviour of a fertile fines andy loam soil under conditions of continuous cropping with barley and of continuous fallowing, as reported in earlier papers from this laboratory, is given.

This soil was used as a culture medium for various crops in an absorption study in the greenhouse, as the result of which the crops, maize, oats and turnips, reduced the concentration of the liquid phase to a low level and entirely depleted the nitrate.

These residual soils were incubated at 27-29° C. after the removal of the different crops and screening to remove some of the larger roots. The moisture was kept constant (14 %). The soils were studied by displacing the soil solutions by the BURD and MARTIN method at from 9 to 161 days after incubation was started, then determining the total concentration (conductivity) and the composition with respect to the more important plant food constituents.

The results of the preliminary study of a soil by this method showed that during the first few days an indication may be gained as to the residual effects of different types of plants on the activity of the soil organisms producing nitrate. The soil, after maize and after turnips, increased much more rapidly during the first two weeks than the soil after oats, bearing out the observations of LYON and BIZZELL several years ago on maize and oats on field plots of soil. Continued incubation for five months showed that following all three crops, the concentration and composition reach levels which are very close to that reached in this soil after eight years fallowing in a container in the field.

The method gives promise of application to the study of the potentialities of a soil for supplying constituents to its liquid phase when its equilibrium is disturbed, giving the information in a very short time.

Comparison of the Methods of Determining the Concentration of Hydrogen Ions of Soils.

NIKLAS H. and HOCK A. *Landwirtschaftliche Versuchstationen*, 104, 87, 1925.

The colorimetric method of MICHAELIS was compared with the colorimetric process of CLARK and LUBS, with the result that the agreement can

be described as very good, as the differences between the electrometric and colorimetric measurement of the soil reaction, according to the experiments of the authors, did not amount, on the average to more than 0.1 in pH values, and the electrometric method being recognized as a basis, the above pigments can be so far considered as excellently suitable for the examination of the soil. K. SCHARRER.

Electrometric Titration in its Significance for the Lime Requirement of our soils.

NIKLAS, H. and HOCK, A. *Landwirtschaftliche Versuchstationen*, 104,93, 1925.

For carrying out the electrometric titration 50 g. soil are shaken for half an hour with 125 ccm. 7.5 % KCl solution, then, after decanting, 10-20 ccm. are pipetted, and, with the help of the universal indicator recommended by the authors, the soil reaction is arrived at by the aid of an electrometer. Then the alteration of the actual acidity is traced, which is apparent if to the soil solution are added known quantities of acid or alkali, whereupon the number of ccs. of acid or alkali introduced are drawn on the abscissa, and the corresponding values for pH on the ordinate of a coordinate system, and the titration curves appertaining thereto are constructed. Most acid mineral soils, with electrometric titration, show their chloride of potassium extraction curves, which point to the presence of $AlCl_3$, consequently to changeable acidity, whereas forest soils show quite a different course of curve, because with them the acidity is caused by humus acids and phosphoric acid. When soil suspension methods are employed, the course of electrometric titration proceeds with difficulty; with sandy and light loamy soils it is successful, but with the heavy loamy and clayey soils, and with many humus soils, it is quite impossible in consequence of the poisoning of the electrodes by the soil colloids. If the total acid in a soil is ascertained by the DAIKUHARA method, using methylene red as indicator, then the quantities of lime calculated from that are certainly minimum values, and are mostly to be considered as insufficient, whereas by the DAIKUHARA method, using phenolphtalein as indicator, values result which are too high, whereby one dose of the amount of lime indicated as wanted might under certain circumstances be too much for many plants. The figures arrived at on the basis of electrometric titration for chemical neutrality lie between the two limits, and may be considered as serviceable results. K. SCHARRER.

On the Quantity and Chemical Composition of Colloidal Clay.

NOVAK, V. SMOLIK, L.: O mnozstsvi a chem. slozeni jilu Kolloidniho. Zpravy.

The following is a summary :

1. Colloidal clay in its widest sense amounts to more than 9 % of the total mass of the soil.

2. The content in colloidal clay proper amounts to 7 % of the total mass of dry soil.

3. The ratios between SiO_2 and (Fe_2O_3, Al_2O_3) in colloidal clays, properly so called, varies between 2.5 and 1.04 : 1. The ratios between SiO_2 and Al_2O_3 run from 4.3 to 2.6 : 1.

4. The content of colloidal clays proper in alkaline and alkaline earth bases is generally relatively high.

5. The organic part of colloidal clay is generally more easily dissolved in a 10 % solution of hydrochloric acid than the inorganic part. Accordingly, it is thought that nutritive substances are more easily set free from organic combinations or complexes than from inorganic combinations.

6. It appears that the basis of colloidal clay in the wider sense is a pseudo-combination of humic matter with alumo-silicic acid. Colloidal clay proper is probably only composed of alumo-silicic acid. The absorbent power of colloidal clay proper, owing to the lesser surface activity of the inorganic colloids, is less considerable than that of clay in the wider sense.

L. SMOLIK.

Researches on Nitrification and Denitrification in Oxidizing Media.

PARISI, E (Istituto superiore agrario. Bologna). *Le Stazioni sperimentali agrarie italiane*, Vol. 58, No. 10-12, pp. 449-472, bibl. Modena 1925.

The nitrification of ammonia occurs regularly in an atmosphere of pure oxygen. This fact, which the writer has proved, enables the phenomenon of nitrification to be studied more intimately and furnishes the method of establishing a complete balance of nitrogen.

The author's experiments show that the combustion of organic matter, such as may be indicated by the production of carbon dioxide, is in proportion to the quantity of oxygen consumed. In permeable soils, then, ammoniacal nitrogen and nitrous nitrogen are completely transformed into nitrates, in an atmosphere containing oxygen; in waterlogged soils, on the other hand, especially in the presence of amino-acids or amides in sufficient quantity, ammonia and nitrous acid are readily broken down and their nitrogen is set free into the air in a molecular state. In such cases, the total decrease of nitrogen is equal to the weight of the nitrogen set free.

Very probably the group $>CHNH_2$ reacts on the nitrous acid according to the formula $>CHNH_2 + HNO_2 = CHOH + H_2O + N_2$, in this way causing a loss of nitrogen double that which would occur through simple denitrification. In a soil containing 15-20 % of water, the consumption of oxygen is more intense than in a waterlogged soil. The presence of sugar however can increase the consumption of oxygen in waterlogged soils to an extraordinary extent.

A. F.

Is Soil Reaction of Importance for the practical Agriculturist ?

TRENEL, M. *Zeitschrift f. Pflanzenernährung und Düngung*. Vol. V, Sect. 4, Part B, 1926.

The work deals with the dependence of liveliness of growth of the different cultivated plants on the soil reaction. The reaction cards of the

estates examined are appended. It is shown that the determination of reaction by electrometrical methods in suspensions containing KCl shows this dependence better than do measurements in watery suspension.

Soil reaction more acid than pH 6.0 injures beetroot, barley and clover. Oats and wheat do well up to pH 5.2 ; potatoes were found insensible up to pH 4.2 ; with rye an optimum could not be recognized. Sorrel and equisetum cannot be considered as definite signs of soil acidity.

The geological conditions of the soil must be taken into account in judging. Referring to this, investigations of the sub-soil, which are given in the reaction cards, deal with this point and are of great value to the agriculturist. L. G.

Soil Biology.

Soil Sickness.

DE GILLIS H. (R. Stazione Chimico-Agraria Sperimentale di Portici). *Le Stazioni Sperimentali Agrarie Italiane*, Vol. LVIII, No. 10-12, p. 373-439, 1 Tab. Modena 1925.

In spite of the numerous investigations on the so-called sickness of he soil, the problem of its determining causes not only remains obscure but demands the recording of experimental researches, based on sure method and extending to the study of the phenomenon down to its characteristic beginnings.

The author has therefore initiated a plan of systematic researches with the object of solving this problem. In this, his preliminary note, he reports on the experiments made with mustard, peas and *Miagrum sativum*. The phenomenon of decreased production is sketched clearly in these researches; in some cases there was an increase rather than a reduction of production, but these were quite isolated exceptions, after which the phenomenon renewed its normal course.

The process of sickness however is not found to be so quick as is generally allowed, though the plants selected were those considered best suited for the purpose. Undoubtedly then the phenomenon is subject to the action of external agents ; thus the summer season makes it more active. It is not possible at present to say whether this corresponds with a more active vegetative growth evolution or with other conditions.

Moreover the sickness exercises greater influence on germinating seeds and on plants in the first stage of growth and it is quite possible that the damage sustained then may be the principal cause of subsequent defects.

The writer proposes to follow up his researches by investigating the effect of aqueous extracts of the soil when it has reached the most suitable degree of sickness, if not of absolute unproductivity. A. F.

Humification Experiments.

CAUDA A. (Asti. R. Istituto Tecnico Gioberti). *Le Stazioni Sperimental Agrarie Italiane*, Vol. 59, No. 1-3, pp. 99-105. Modena, 1926.

The aptitude of agricultural soil for transforming cellulose into humus varies from one soil to another owing to the presence or absence of humifying bacteria and depends on its constitution and composition.

The author investigated this bacterial activity in various soil samples :— meadow soil, soil under willow trees, willow mould, plane tree mould, of which only the willow mould caused total humification of wheat straw and the fruit sheaths of maize.

The humification takes place at a high temperature (30°C.), with cold it slows down or is prevented. From other experiments the author deduces that ammonium sulphate also retards and hinders humification. Immersion in water prevents, while light does not hinder the formation of humus.

Coprinus and the bacterium of peat cause a noticeable transformation into humus ; the former gives rise to colonies of the appearance of paraffin, with development of ammonia, while a bacterium is isolated with colonies mostly white, red, yellow, brownish, capable of humifying straw with much blackening and giving off an earthy smell of beet.

We cannot speak of a true transformation into humus in the case of the ordinary mushroom or of fermented tobacco.

The Effect of Sulphur on the Microflora of the Soil.

FIFE, J. M. (Utah Agr. Exp. Station), *Soil Science*, Vol. XXI, pp. 245-252, 1926.

This is a report of a study made on the influence of varying amounts of sulphur on the soil microflora as measured by numbers, ammonification, nitrification, azofication and the rate at which the sulphur is oxidized to sulphates.

Three soils were used in the experiment. soil " A " with a low organic matter content, soil " B " with a high organic matter content and soil " C " with a medium organic matter content.

The sulphur applied ranged from 100 to 1000 pounds per acre.

According to the author sulphur greatly stimulated ammonification in all three soils with soil A leading. Nitrification was stimulated in soil B by sulphur in all concentrations with the exception of the highest applications. Sulphur was very toxic in soil A. Although the sulphur was very toxic at all the lower concentrations in soil C, a great stimulation occurred in the higher concentrations. The sulphur was without effect on azofication during the short time the soil was under observation. There was a general decrease in the number of bacteria over the period the counts were made in the treated and in the untreated soils. Soils A and C showed a very slight increase in bacterial numbers. J. S. JOFFE.

The Bacterial Types Occurring in Frozen Soil.

LOCHHEAD, A. G. (Central Exp. Farm, Ottawa, Canada) *Soil Science*, Vol. XXI, pp. 225-231. Baltimore, Md.

This is a report of an investigation on the bacterial types occurring in frozen soils of Eastern Canada. The field soils had been frozen for more than 2 months. The number of bacterial colonies appearing on albumin agar at 3° C was less than 10 % of those at 20°C, most of the bacteria of

frozen soils being incapable of low temperature growth. At 20° C the most abundant type was the group of non-sporulating short rods, non-liquefying or slowly liquefying, and the next most abundant group was that of *Actinomycetes*. Rapidly liquefying rods and micrococci were found to be numerically unimportant. At 3° the non liquefying short rods formed a higher proportion of the bacterial colonies, the other groups showing even less capability for low temperature growth than these forms. The microflora of frozen soils does not appear to exhibit characteristics different from those found at other seasons. Sixteen type species, isolated from nutrient agar plates at 3° have been described, as well as their frequency. Two types predominate — both non-sporulating short rods — one slowly liquefying, one non-liquefying, and they appear to be representative soil types of other seasons which develop better at more moderate temperatures.

J. S. JOFFE.

Handbook of the biophysical and biochemical Investigation of the Soil.

STOKLASA, J. in collaboration with DOERELL, E. G. With 91 text illus. pp. 812. Paul Parey, Berlin, 1926.

The book contains what the title promises. It is a work which recapitulates our present day knowledge in the field of biophysics and biochemistry of the soil, with a clear arrangement of the matter, a clear representation and full comprehension of the subject. Space forbids more than a short summary, which will suffice however to show that its comprehensive and enlightening account of soil problems is of the greatest scientific importance.

In the section on biophysical and biochemical examination of the soil the general methods of soil examination are first of all described, particularly the mechanical analysis of the soil and the determination of water capacity, also the analysis of the soil air. Further sections deal with its chemical analysis, the determination of the soil colloids, of its electrical conductivity and its catalytic agents. The section on soil reaction gives a comprehensive account of the numerous electrometric and colorimetric methods. There follows then the description of the special chemical examination of the soil, particularly of the determination of foodstuffs in soil extracts. Of especial interest is the next section on radioactivity in the soil and in the soil air, and its influence on the germination and development of plants.

The second main section of the book covers the methods of biological investigation of the soil. After general observations on the micro-organisms present in the soil, the bacteria of the rhizospheres are described, and the methods of the examination of edaphons demonstrated. After a comprehensive description of the bacteria taking part in the nitrogen cycle in nature, there come sections entitled : Synthesis of albumen in the soil, methane-decomposing and hydrogen-oxidizing bacteria, sulphur bacteria, desulphurizers, iron bacteria, actinomyces, soil fungi, soil algae, protozoa. There follows then a description of them. Determination of the results of bacterial respiration is then described, as are biological absorption, and biochemical

methods for determining the hydrated phosphoric acid and oxide of potassium contained in the soil in an assimilable state. The further chapters concern :— soil respiration, carbon dioxide as basic factor, methods for determining the carbon-dioxide produced by the soil, connection between organic substance and heterotrophes, between the chemical character of the organic matter and the respiration process, breaking up process of the cellulose in the soil, oxidization processes of the nitrogen-containing organic substances in the soil, respiration intensity of the micro-organisms, respiration of forest soils, composition of drainage water as an indication of the bio-chemical processes in the soil, effect of stable manure on the mechanics of the respiration process in the soil, influence of radioactivity on the dissimilation process of the micro-organisms in the soil. It is in short an outstanding work which should be in the library of all soil scientists.

SCHUCHT.

Soils and Vegetation.

The Significance of Traces of Elements upon the Growth of Young Orange Trees.

HAAS, A. R. C. and REED, H. S. Riverside, California, Citrus Exper. Station.

Characteristic injury to the foliage of young orange trees is often observed in sand culture experiments. The injury does not occur in sand cultures where tap water is employed in making the nutrient solutions, but is prominent where carefully distilled water and pure chemicals are employed. The difficulty is overcome by adding to the supposedly complete culture solutions minute amounts of a suspension containing aluminium sulphate, potassium iodide, titanium sulphate, potassium bromide, strontium nitrate, lithium nitrate, manganese sulphate, boric acid, and ammonium nitrate. It is improbable that all of these ions are necessary for alleviation of the difficulty, and future work is in progress to ascertain those which are essential.

X.

Contribution to the Question of the Influence of Pure Spruce and Beech Stocks, as well as Mixed Stocks formed by both kinds of trees, on some qualities of Forest Soils.

KVAPIL, K. and NEMEC, A. (From the Biochemical Institute of the State Forest Testing Station at Prague). *Zeitschrift für Forst- und Jagdwesen*, year 57, pp. 193-231. With 11 tables, 3 diagrams and 2 illus.

The authors show, from a big series of physical, chemical and biochemical examinations of the same soil, that the influence of pure spruce stock on the sandy, primitive mountain loam of East Bohemia (in the forest part of Tremosnice near Caslau, height above sea level 420 m., average yearly temperature 8.4° C., annual precipitation 646 mm.) is much more unfavourable than that of pure beech stock. The favourable conditions induced by the latter were reached, or even surpassed, if beech and spruce were mixed.

Kopecky's suspension analysis shows that all three soils (at a depth of 35 cm.) maintain a normal and fairly similar condition.

But the fine sand content of the pure spruce soil is the greatest, amounting to 32.5 % by weight, which points to a more unfavourable physical condition of the soil.

Following BURGER's view that the air capacity is the most important indicator of the fruitfulness of forest soils, these are the only physical figures to be worked out, and are in absolute values: beech 22.37; spruce 15.00, mixed stock 26.73. These figures themselves suffice to show the unfavourable influence of the pure spruce stock, and the favourable influence of the pure beech and also of the mixed stock.

The *analysis of nutrient matter* (boiling the soil with 10 % Hydrochloric acid) gives a corresponding picture:

Table III. (*abbreviated*).

Kind of wood and type of soil	Content of nutrient matter in % of dry weight				Organic matter in %
	P_2O_5	K_2O	SO_3	CaO	
Beech, mineral soil	0.228	0.039	0.449	0.117	4.73
Spruce »	0.005	0.021	2.599	0.081	1.58
Both mixed »	0.144	0.047	2.606	0.187	4.89

Determinations of nitrogen were made by methods which I shall explain at another time for humus and mineral soils (surface layers). They were then separated and differentiated again into nitrogenous compounds, soluble in concentrated HCl such as amides and diamino-acids. The spruce humus most rich in total amount of nitrogen (1.473) contains it however in a very insoluble form, so that it only passes into the mineral soil to a small degree. These unfavourable food conditions for the trees, obtaining in woods of pure spruce, can be made just as favourable as those in pure beech woods by mixing spruce and beech, as the following figures show :— Beech humus 0.867 % N, beech mineral soil 0.231 % N., spruce humus 1.473 % N, spruce mineral soil 1.58 % N, mixed stock humus 1.269 % N, the like mineral soil 0.282 % N.

The *acidities* (total, relative to titration acidity, actual and exchangeable acidity) are such in their values that the spruce humus is most acid with 4.6 pH, and with 6.2 pH the mineral soil of the mixed stock is almost neutral. They were determined colorimetrically by MICHAELIS' method (indicators without buffers).

The *catalytic power* (action of catalysis) of the soils showed itself to be in the closest dependence on the degree of acidity, whilst the most acid was least capable of releasing oxygen from hydrogen peroxide.

The *ammonifying power* was also shewn to depend on the degree of acidity and the amount of organic matter present, Tests by Remy's method gave the following results :—

Spruce 19.42 mg.; beech 85.44 mg.; both mixed 75.33 mg. N. (10 g. humus overlying mineral soil and 100 cm. 1 % Witte peptone solution).

The values of the *assimilation of the atmospheric nitrogen* were in the same relationship in the humus beds of the three stocks as were the bio-chemical qualities investigated up to now, in that pure beech showed a recovery of nitrogen of 14.85 %, pure spruce only 11.6 %, and the mixed stock 39.2 %. The mineral soils, gave rather a different result. The mixed stock, with 49.5 %, was the best, then followed pure beech with 27.8 %, and the spruce even showed loss of nitrogen (denitrification).

The nitrate formation, determined by the VHAMOT-PRATT method by reduction of the nitrate into picric acid, is shewn by the following figures, according to which pure spruce again comes out most unfavourably:

From Table VIII.

1000 g. humus in relation to mg. nitrate (net value) yielded:

Beech humus	128.2;	spruce 94.2;	the two mixed 168.3
Beech soil	77.4;	spruce 59.3;	the two mixed 88.8

The *phosphoric acid adsorption* was shewn to be exactly proportional to the degree of acidity. The acid spruce humus could only retain 16.6 %, while the mineral soil of the mixed stock, on the other hand retained 74.10 %.

The *cellulose decomposition* is demonstrated by illustrations. According to that, the three humus layers are approximately alike in operation. The strips of filter paper are but little consumed. But in the mineral soils, on the contrary, the strips of paper pressed by the mixed-stock soil are almost completely decomposed, while those in the spruce soil are almost completely untouched.

The *fermentation intensity*, determined by ALBERT and LUTHER's method in Ivanoff vessels with quicksilver manometer, is likewise smallest (40 mm.) in pure spruce soil; in beech and mixed-stock soil on the other hand being three times as great.

The *measurement of the chemical light intensity* in bunsen Roscoe units by WIESNER and CIESLAR's method leads to the conclusion that each individual corona of the mixed stock absorbs a somewhat greater quantity of light than the corona of the pure beech and particularly of the pure spruce wood.

According to all the data, there appears to be no doubt that for the sandy original mountain loam investigated, and the climate and conditions mentioned, which occur so frequently, the mixed forest formed of leafy and needle woods influences the general condition of the soil more favourably than pure stocks, and very much more favourably than the pure spruce stock. The important bio-chemical factors of the soils, are affected most.

GROSSKOPF.

Regional Soil Science

The Vegetation of Switzerland.

BROCKMANN H. JEROSCH. First series, Part I. Der Boden. Rascher & Co. Zürich, January 1925.

Of this very important work of the well known botanist and geographer, the first part on the soil interests us the most. The author states

his intention clearly in the headings of both chapters :— I. " Attempt to define the soils of Switzerland " and 2. " Surface formations and soil conditions in their relationship to vegetation ".

It may be surprising that a geographer and botanist should be the first to give a survey of the kinds of soil occurring in Switzerland, and of their distribution. The reason lies in the very small attention paid in the Swiss colleges to pure soil science and in a noticeable absence until recently of systematic, geographical, scientific soil investigation. That under these circumstances the work under discussion was a bold venture is clear, and it is to be expected that in many respects, from the point of view of a soil expert, many deductions of the author must appear as somewhat hasty.

In the first chapter the author gives, by the aid of the (somewhat altered) scheme of LANG a survey of the climatic types of soil, and advances the statement that in Switzerland there must be almost all types of soil, from arid to ultra-humid. As arid soils the author understands places where, especially in the mountains, through the action of water, lime encrustments occur, or where, under overhanging rocks, in caves, etc., there are efflorescences of salt. Included as humid soils occurring in Switzerland are yellow brown and humus soils, and as ultra-humid soils, podsol soils. The soils in the high mountains are partly designated as frost soils.

The author emphasizes with reason that as a result of the geological youth of Switzerland, and also especially because of the continual metamorphosis through demolition and upheaval, there are still present immature or very slightly disintegrated soils. This explains the great importance of the mother rock, and there results, therefore, as a consequence of the geological multi-formation of the surfaces a mosaic of the most varied kinds and conditions of soil.

In the 2nd. chapter the " superficial forms and soil conditions in their relation to vegetation " are dealt with.

In the centre the last two glacierizations, with their erosive action (principally by water) and discharges (moraines and fluvio-glacial boulders) form the character of the soil. The soil is conceived climatically as brown earth, which in any case, through the mother rock, is of very varied kinds.

The soil of the Jura is represented as being very dependent on its geological origin, and a tendency towards the formation of brown earth is assumed.

It is clear that the Alps must exhibit the most extended variety of soils. With the lack of exact investigation, it is naturally very difficult to get an insight into the actual conditions. BROCKMANN, therefore, ventures " no longer to pass by such important matters without bringing them within the range of our consideration ".

Encrustments, as mentioned above, are comprehended as arid soil formations. In relatively dry valleys (Wallis, Schanfigg) the author expects the appearance of yellow soil, and sees, in the various places where loess occurs, soils which incline towards the formation of yellow soils. A study of the effect of the wind on soil formation in the Alps is certainly well justified.

Ultra-humid climate at great altitudes, and in the valleys with high precipitation, on the northern border of the Alps, leads to Podsol soil.

In conclusion, three short sections are devoted to the frost soils in places where no chemical disintegration can take place, and to the soil movement anu minute life of the Alpine soils.

The " attempt " of BROCKMANN has given the soil expert a very stimulating work. Of technical soil literature only that of LANG, WIEGNER and Graf zu LEININGEN is quoted. Further literature appears to be unknown to the author (for example RAMANN, Soil formation and soil classification). There are no analyses at all. The author states many times, however, that " at many places only individual observations were made " and " there might be omissions " (p. 34 and p. 49).

We consider that in reality the soil formation in Switzerland possesses a more humid character than is generally assumed to-day. More or less certain formations of Podsol soils are not rare in the centre of the country (particularly on gravel and loess), as a number of recent observations and works satisfactorily prove (WIEGNER, JENNY, JENNY and BRAUN-BLANQUET, MEYER, SIEGRIST and GESSNER). If the work of BROCKMANN-JEROSCH stimulates to detailed investigations, it will certainly have rendered a great service. GESSNER.

On the Causes of the Displacement of the Coast Line.

CREMA, C. Spostamenti della linea di spiaggia presso Favazzina nel Golfo di Gioia. *Boll. del R. Ufficio geologico d'Italia*, Vol. I, No. 9, pp. 1-13, 1 map, 1 fig. Rome, 1925.

Between the stations of Bagnara and Favazzina on the Tyrrhenian coast railway a retrogression of the sea coast, formed in that locality by deposits of the Favazzina torrent, has been ascertained. As principal cause of this phenomenon is to be considered marine erosion no longer counterbalanced by fresh deposits of materials by the torrent, the latter having changed its habit in consequence of the earthquake of 1908.

No other action can presumably be invoked to explain it, not even gradual earth movement which sometimes helps to cause variations of the coast line, seeing that no authoritative observations admit of such taking place on the coast investigated, and also the action of such slow movements could not attain appreciable importance in face of the so much more energetic action of tidal waves. Such phenomena may always, as in the case under survey, develop great importance, but only when the littoral is of a rocky nature.

Such changes in proximity to the mouth of a stream should always be regarded as possible whenever it is desired to effect the regularization of catchment areas. A. F.

The Reclamatian of the Lower Friuli.

FERUGLIO, D. and FERUGLIO, E. (Staz. Chimico-agraria sper. di Udine). La zona delle risorgive del Basso Friuli fra " Tagliamento " e " Torre ". *An-*

nali della Stazione chimico-agraria sper. di Udine, Ser. III, Vol. I, pp. 1-479, II Tab., 4 maps, bibl. Udine, 1925.

The vast zone which the writers deal with in this geological, hydrological, and agricultural paper comprises fifteen thousand hectares of land situated in the centre of the Friulian plain, for the greater part swampy and everywhere under difficult drainage conditions The soils have a diversity of texture and composition, but are almost always covered over by a considerable humiferous layer and variously clothed with self sown marshy and shrubby vegetation.

Few efforts have as yet been made by private agriculturists to free their property from the curse of these spring waters, which if suitably controlled and adapted to irrigation would, owing to their very excellent temperature and composition, actually tend greatly to increase the agricultural value of the land.

The reclamation of this zone is evidently beyond the power of private initiative and can only be expected to be undertaken as a public enterprise.

In the region investigated, from the point of view of reclamation, three zones may be distinguished :— An upper zone which includes the perimeter of the springs, in which the importance of the overflowing from the artesian strata is considerable ; an intermediate dry zone, such as can succeed with a rational arrangement of drainage ; a lower circum-lagunary and delta zone, for the most part still marshy.

Provisions contemplating the mechanical raising of the drainage water are only necessary for the third zone. In the first and third zones there is absolute predominance of marshy growth, while in the second zone cultivated fields, more or less dry meadows and wooded areas prevail, the last of which however have to a great extent disappeared. The regularization should primarily be directed to the streams which collect most of the water into the irrigation channels of the springs so that the great masses waiting for dispersion of the side rivers (Tagliamento and Torre) may be promptly collected and got rid of.

Other essential works should be completed so that on the one hand the main streams and the torrential water courses may no longer form an obstacle or a danger to subsequent operations of agrarian reclamation, and on the other hand a sufficient quantity of irrigation water may be supplied.

Then considering the considerable extent of the zone represented by gravelly-sandy alluvia, with little natural fertility, ground elevated from the important superficial accumulation of humus, it is understood that a simple drying process of the land would undoubtedly lead to a great decrease in production. The zone would therefore be transformed into an area needing irrigation and for this purpose the considerable power of the overflow from the water holding strata in the upper zone is such as to assure any increase in consumption.

In the circum-lagunary zone the irrigation water would also serve very well for removing salt from the soil.

Agricultural improvement should go therefore hand in hand with these

water schemes and the technical agricultural programme should be based on the irrigation schemes. Water meadows and grasslands, cattle breeding, dairying, the cultivation of osiers, poplars, alders and, in process of time, the erection of human habitations in the hitherto unpopulated zone may be expected. The work will be facilitated by the fact that, under a recent ruling, the zone investigated is comprised in the first category of lands for reclamation. A. F.

Soil Formation, Colonization and Succession of Plant Associations on the Aar Terraces.

GESSNER, H and SIEGRIST, R. *Mitt. der Aargauischen Naturforschenden Gesellschaft.* Vol. 7, pp. 54, 1925.

The authors examined the meadows of the Aar Valley at different heights in the neighbourhood of Aarau in the Centre of Switzerland. The results of the soil examinations are given briefly:

A) In the so-called *high water channels*, the districts of the real river bed, the recent deposits (sand and gravel freshly washed out by high water) show a high but evenly distributed content of lime with on the average 25 % of $CaCO_3$. Also the humus content of this sand, poor in vegetation, is remarkably high (4 ± 0.4 %). On passing over to the fertile forest land, the humus content rises in the uppermost layer to 8 %. A slight washing out of lime is already confirmed here. Soil reaction neutral to weak alkaline.

B) *The lower terraces.* — Result of the last ice period, bears mixed woodland. Corresponding to the great age of this stage, the disintegrating progress of the soil in a humid climate is here plainly shown. The beginning of podsol formation is demonstrable by muriatic acid extractions, complete washing out of carbonates up to 1.2-1.8 m. deep, distinct washing out of sesqui-oxides and increase of the same in the lower lime free layers Reaction weakly acid, humus content up to 22.4 %.

C) *High terrace.* — Result of the ice period prior to the last. On account of the great age of these deposits, the formation of podsol soil is more sharply marked, and can be confirmed by the naked eye (photo). The upper levels of the soil are perfectly free from lime, and have a strong acid reaction (pH up to 4.9). The humus content falls with increasing depth, the subsoil being rich in $CaCO_3$. Unfortunately, only the podsol layer is sufficiently analysed.

Many tables, drawings and photographs make the work very clear. It must be given credit for first emphatically drawing attention to podsol formation in Central Switzerland. H. J.

The Diamond fields of South West Africa.

KAISER, E. Die Diamantenwüste Südwest-Afrikas. Explanation of a special geological map of the southern diamond fields 1 : 25 000, drawn up by W. BEETS and E. KAISER. 2 volumes with many tables, maps and illustrations. Dietrich Reiner (Ernst Vohsen) Berlin, 1926.

Seven years after the loss of the South West African protectorate a work has appeared which represents, scientifically, the most important

production emanating from this field of labour. Whilst PASSARGE's ehxaustive work on the Calahary only touches the eastern portion of the former colony, and SCHULTZE's able work "Aus Namaland und Kalahari", along with a general description of the country, plunges into an affectionate consideration of the natives, we have here before us a work which, starting from the interesting coastal deserts of South West Africa, collects there fruitful detailed results, and makes use of them for far-reaching conclusions with respect to the waste districts of other parts of the earth.

It is impossible, within the limits of a short description, to do justice to all the details of this exhaustive work, nor can the numerous individual contributions be gone into, which have been made to it by BEETZ, BOEHM, MARTIN, WAUFF, STORZ, STROMER, WEISSERMEL, WENZ, and WILLMANN. They go deeply into the results obtained by investigating special geological, paleontological and petrographical questions. The sections written by BEETZ are closely connected with the investigations of KAISER, so that they must be considered in conjunction with them.

Diamonds were discovered in the year 1908 in the most desert parts of South West Africa. The discovery soon proved itself much more important than was at first supposed, and gave rise to the founding of several diamond companies. The most important of these was the German diamond company, to which belonged the extensive diamond district south of the Lüderitzbuchst railway. That this monumental work has been made possible is mainly due to the former Director of this Company, Dr. HEINRICH LOTZ, who made it possible to send Professor KAISER, and was able to provide special sums for the carrying out of the work.

The whole work is based on the geological map on a scale of 1 : 25000, which was drawn up by KAISER and BEETZ. It is in 7 sheets, included in the first volume of the work, and even on the desk, in its special representation, permits a glance into one of the most interesting waste regions of the earth. The importance of the work, however, goes far beyond the explanation of the special geological maps, and gives in particular the picture of the origin of the desert. In the first volume, after a short survey of the geology, the structure of the old mountains of the primary formation of South Africa is given. The primary formation consists of gneiss, mica schists and chlorite schists. There also appears granite-gneiss, which is metamorphosed from younger granite, also veins of these granite injections, and converted basic rocks of volcanic origin.

Above the primary formation lie the Concip and Nama formations B. dealt with by BEETZ. As a result of extensive travel in the interior of South West Africa, it was possible to parallel these old fossile-free sedimentary layers with the formations in the interior already arranged earlier by RANGE; in consequence of the special mapping of the desert regions, the Nama formation in particular could be here drawn up in detail. Even in these oldest sedimentary formations numerous volcanic rocks appear. Whilst in the older crystalline foundation mountains acid volcanic rocks are most prominent, basic rocks predominate in the suspensory stage of the primary formation and the Concip formation. In part

these volcanic rocks possess great geological age, in opposition to the alkali rocks and allied rocks, which did not arise until during a jurassic-cretaceous levelling period, which followed the levelling of those formations. These alkali-syenitic rocks were specially examined and described in the Granitberg and in the Klinkhardtgebirge. On these levelling surfaces the old layers were then deposited in younger eocene and miocene forms, as described by BEETZ at the beginning of the second volume. In these layers were found, amongst other things, interesting remains of vertebrates which STROMER von REICHENBERG has described thoroughly. These throw new light on the geological past of South Africa. In the tertiary deposits we already find diamonds, which then, by working up, have in part undergone such enrichment that they represent the richest diamond appearance of the whole region. The primary beds whence the diamonds originate must therefore be older than eocene, and approach very nearly to the age at which the South African geologists place the upper lime of Kimberley. KAISER and BEETZ come to the opinion that neither dark blue beds under the sea, nor the Orange River, nor the Benguela come into question as conveyors of the diamonds; the origin of the diamonds must rather be sought inland in South West Africa under the deposits of the dry climate. The dry flows of the oldest tertiary time have in their course carried to the coast the diamonds washed out of the mother rock, and bedded them in the layers deposited by them. There, where the eocene sea has spread out the layers, or the lower miocene rivers have washed them out, they appear in a richer state. The richest beds have been blown out of this deposit again by the wind.

These isolated samples of the work must suffice to show the special results of the two investigators.

The other great undertaking which KAISER has set himself is to follow up all the factors of the desert formation in their relation to each other. So he shows us in a masterly way the processes of the mechanical rock preparation and rock deposit in a dry climate. Water and wind are dealt with thoroughly. It is shown how far-reaching are the effects of water even in the dryest parts of the desert, where they would be least expected, and where many investigators have spoken of a purely mechanical rock preparation. Attention is also drawn to the importance of the wind, for which this wind-ravaged part of the coastal deserts is particularly notorious. The investigations on the re-deposit of silicic acid are also of very great importance. Their elimination again takes place in the coastal districts in greater proximity to the source of origin than in a humid climate. Nearly all the rocks are silicated. Under new formations of silicic acid formation are understood all the processes which play a part in and after penetration of the silicic acid coming from outside into the mineral residues present. The carbonate rocks of the Nama formation in particular present a good field of reaction for the silicic acid. Also the tertiary Pomona quartz and the surface lime are strongly silicated. The silicification processes are extended over a long period of time, beginning with the chalk period. An optimum is given by the passing over from normal arid to extreme arid climate. For the formation of a strong si-

licated covering, a long maintenance of the form of the upper surface of the land is necessary. Of the young, sedimentary, new formations in the desert climate, the wind borne sands are thoroughly dealt with. The appearance of these is different in sand drift and sickle shaped dunes. Both are streamline bodies, but of quite different form and origin.

The work is beautifully got up. Two coloured title illustrations after pastels of the well known South African painter AXEL ERIKSON give a picture of the beautiful colours of the desert. 54 tables explain the landscape and geological profiles, indicate the morphogenetic processes, and again give the fossils dealt with. 32 stereo-illustrations make possible a glance at the small forms of the desert. Numerous text illustrations explain the text. The special geological maps are supplemented with maps of the Granitberg, a morphological map of the Wannen country, and one of a journey amongst the dunes. The price for the beautiful work is put low, its appearance being made possible by contributions to the costs of printing which were granted to the publisher. RANGE.

The Composition of the Fractions Separated by Mechanical Analysis from some Transvaal soils.

MARCHAND, B. de C. and van der MERWE, C. R. *South African Journal of Science*, Vol. XXII, pp. 104-118. Johannesburg, 1925.

A brief review of the literature on the above subject, outside South Africa, is given and then the mechanical analysis and the chemical composition of the various fractions discussed of (*a*) sandy soil types and (*b*) heavy soils. The mechanical analysis is done according to the (HALL) beaker method and the soil separated into seven fractions.

Typical mechanical analysis of sandy soils from four different rock formations are given as well as the ultimate chemical analysis of each fraction. The silica decreases while the alumina, iron oxide and phosphoric oxide increase, as the size of the particles decreases. The phosphoric oxide is concentrated to a great extent in the clay fraction. Lime, magnesia and potash also increase as the size of the particles diminishes up to the very fine silt fraction which usually contains more of these constituents than the clay. In sandy soils derived from granite, the coarse fractions, however, show a higher percentage of potash than the finer fractions.

With regard to the heavy soils, the heavy red loams and the black clay soils (turf soils) are taken as samples.

With the heavy red loams (derived from ferruginous, basic igneous rocks) the silica decreases regularly and alumina, magnesia, and phosphoric oxide increase generally as the size of the particles decreases. The potash shows considerable irregularity, but the finer fractions as a rule are richer in that constituent than the coarser ones. Since these soils have a high clay percentage (40-50), the phosphoric acid and also potash are largely concentrated in the clay fraction.

The black clay soils are also derived from basic igneous rocks (see MARCHAND: " The origin of the black turf soils of the Transvaal " this Review, Vol. IV, No. 3, page 6, 7), and contain a varying amount of free calcium

carbonate. Silica and lime decrease, as a rule, as the particles decrease in size. The general tendency is for the alumina, iron oxide, magnesia, potash and phosphoric oxide to increase from the coarser to the finer soil fractions, with slight irregularities here and there.

In conclusion the physical properties and the composition of the clay fractions of the above two types of heavy loams (red and black) are compared and the very marked differences discussed. MALHERBE.

Seasonal Variation in Salinity of Nile Water at Rodah (Giza) with Special Reference to Alkaline Carbonates.

ALADJEM, R. *Technical and Scientific Service Bulletin*, No. 69. Ministry of Agriculture, Egypt.

Chemical research on Nile water has been made since 1812 by several writers, but until the recent work of M. Victor MOSSERI no attention had been paid to alkaline carbonates and the resulting alkalinity of Nile water at certain periods of the year.

The writer's researches which were carried on for two years (1924 and 1925) have dealt with samples of water taken weekly from the Nile, below the Rodah bridge, at a depth of 2 metres.

The total amount in solution, the alkaline carbonates, the total bicarbonates and the chlorides have been determined. The WINKLER-CAMERON method, inaugurated in Egypt by M. V. MOSSERI, has enabled the bicarbonates and the soluble carbonates to be separately determined.

From tables and diagrams drawn up by the writer it is shewn that the salinity of the Nile is at its maximum when the river is at its lowest, and that the bicarbonates form the most important fraction of the soluble total.

The origin of this alkalinity should be sought in the White Nile, being the result, according to all evidence, of the evaporation of the water which reduces the alkaline bicarbonates to carbonates. This change occurs either during the flow of the water of Lake Albert to Assouan, or in the reservoir of Assouan itself.

The waters of the White Nile are themselves enriched in alkaline carbonates by the Bahr el Gebel, which, during its passage through the Sudd, loses about half of its volume of water by evaporation.

Moreover, the waters of Lake Albert, of which some samples supplied by Dr. HURST have been analysed by the writer, are very rich in bicarbonates and contain a relatively high proportion of alkaline carbonates; but these waters do not appear to contribute to the alkalinity of the White Nile.

Most of the dissolved matter contained in Nile water is formed of bicarbonates, especially bicarbonates of magnesium and calcium.

The quantity of chlorides is very small, the maximum (47 parts per million expressed as NaCl) taking place at low water in May. The chlorides become appreciable, not only in consequence of the concentration of the Nile water at that period, but also because, like the bicarbonates, they are brought in by subterranean water which is discharged into the river.

Alkalis only form a small fraction of the dissolved matter in Nile water, which confirms previous researches of M. Victor Mosseri, and the writer shows that this water contains in solution more lime and magnesia than potash and soda. If this had not been the case Egyptian lands would long ago have become sterile. V. M. M.

Carbonates and Bicarbonates in Solution in Nile Water.

Mosseri, V. M. Bull. Inst. of Egypt. 1925.

The presence in irrigation water of alkaline carbonates and especially of sodium carbonate beyond a certain, always very small, percentage is objectionable. What matters most is the nature of the salts remaining after the evaporation or absorption of the irrigation water.

Though the Nile water and the subterranean waters do not ever contain dangerous proportions of alkaline carbonates, they have on the other hand appreciable quantities of bicarbonates, among others alkaline bicarbonates, which sometimes are transformed into very harmful alkaline carbonates.

The composition of the matter in solution in Nile water had only hitherto formed the subject of fragmentary and incomplete researches; the writer is the first person to make a systematic study of the question and to make separate determinations of the carbonates and bicarbonates, which he has done by means of the Winkler-Cameron method .

These determinations, started in 1906 on irrigation and drainage water as well as on subterranean water, have been made regularly since 20 April 1924 on the waters of the Nile itself, being taken every 7 days at a depth of 2 metres at two different places of the river at the Cairo level.

Besides carbonic acid of the carbonates and bicarbonates, the writer determined the total soluble content and the chlorine, and estimated the total CO_3 of the carbonates and bicarbonates. These data expressed on the one hand in milligrammes per litre and on the other in percentages of the soluble total have been condensed into two tables and compared with the approximate discharge of the river above the Delta dam.

It appears from these figures that the alkaline carbonates (and silicates) are most abundant (6 to 11 milligrammes per litre expressed as CO_3) during the last three months of low water (May, June, July) : the alkaline reaction with phenolphthalein is then appreciable ; while it is scarcely perceptible during the rest of the year and becomes nil from the middle of November to the end of January.

The bicarbonates are present throughout the year ; their quantity, expressed in HCO_3 and in milligrammes per litre, varies from 98 to 159 with a maximum in June and July and a minimum from September to December.

The fluctuations of the bicarbonates as well as those of the total of carbonates and bicarbonates (total CO_3) are similar to the variations of the chlorides, except in May and June. The quantity of various elements, expressed in percentages of the total soluble content, show that, expressed in CO_3, the alkaline carbonates (and the silicates) represent 0 to 5.5 %, the

bicarbonates 55 to 44 %, the total of carbonates and bicarbonates 36 to 45 % of the total soluble content.

The writer, after having pointed out that in order to discuss these results usefully the quantity of silicates must be determined as well as the nature and the proportion of the various bases present in the Nile water at different periods of the year, insists on the importance of this question, which should not be lost sight of in works for regulating the river.

V. M. M.

The Fertility of Egypt.

MOSSERI, V. M. *Comptes Rendus du Congrès International de Géographie du Caire,* Vol. IV, pp. 135-168.

In the first part of his paper the writer deals with the agricultural wealth of Egypt and its principal factors, namely:— geographical position, climate, the peculiar character of the peasants, the soil and the river which waters it.

The remarkable geographical position of Egypt has had the most fortunate results on its commerce, supported almost exclusively, so far as exports are concerned, by agricultural produce, and on its flora, of which numerous representatives especially most of the plants cultivated at the present time are of foreign origin.

As the writer remarks, the history of the botanical acquisitions made by Egypt in the course of centuries is not only the history of its agriculture but also that of its external relations. According to SCHWEINFURTH, that history is divided into six periods, in the course of which Egypt borrowed much from tropical Africa, Arabia, Babylonia, Persia and India, Syria and Armenia, the Balkan Peninsula and more recently from America, thus collecting in its midst, thanks to the fortunate combination of the soil conditions, climate and irrigation, the greater part of the agricultural flora of the world. Recent attempts at new introductions have also been fortunate.

The climate of Egypt, regular, free from injurious extremes and from excessive dryness allows of the production of superior cottons in the Delta, cultivation of maize in Lower and Middle Egypt and of bersim, the most valuable of the Egyptian leguminous crops, from Assouan to the Mediterranean.

Although uniform as a whole it has however sufficiently marked differences between the south and north to impose on the agriculturist some discretion in the choice not only of the species but also of the varieties to be grown. It is thus that the growth of fine cottons is the speciality of Lower Egypt, that Upper Egypt, where coarse cottons are produced, is preeminently the region of the sugar cane for industrial use, of sorghum, onions, lentils and even of the bean ; that maize is uncommon outside Lower and Middle Egypt ; that rice, dinebe and samara are reclamation crops confined to Lower Egypt and the Fayoum.

After having sketched the character of the Egyptian fellah, whose aptitude is remarkable, and indicated the measures which should be taken to safeguard the qualities and health of rural labour, one of the principal fac-

tors of the prosperity of the country, the writer deals with the investigation of the soil of Egypt and the Nile. The genesis of these soils and the investigation of the Nile water are here related, as they have already been at greater length by the writer in previous publications (notably in " Agrological notes on the Egyptian Soil "). In the second part, the writer examines the conditions which in former times, under the regime of irrigation by basin, assured the maintenance of the fertility of the Egyptian soil ; he passes in review, as he had already done in a previous publication (" On the Egyptian soil under the regime of irrigation by inundation "), the many benefits of the fallow period, called *sharaqi*, the suppression of which under the present irrigation system is very harmful.

V. M. M.

Contribution to the Characterization of Soils of Hanâ, Czecho-Slovakia.

NOVÁK, V. Prispevek Kcharakteristice pud. Hané. *Zpràv vyzkumnych ustavu zemedskych c.* 3 *Ministersivo zemedelstvi Prague* 1925.

This essay is a preliminary study of the typical soils of Hanâ. Hanâ is the flat country of Central Moravia, celebrated for its crops of malting barley. The general characteristics and the climatic seasons of this country are first of all described. The description of three sections of the soil of the following places :— Ivanovice, St. Ves near Prerov, and Hulin is given. The characteristics of the soil profiles are given by mechanical and chemical analyses.

The soils investigated are all " tchernozion " black soils slightly degraded. These black soils appear in two variations. The Ivanovice profile shows black soil with a tinge of brown — this is the soil of the drier places — with a layer of humus of a maximum depth of 70 cm., while the St. Ves and Hulin profiles show a darker, black soil, — this is the soil of the moister places with a layer of humus of a greater depth than 70 cm.

L. SMOLIK.

The technical investigation of the soil of the fields of the Agricultural School at Zhar in Moravia, and the immediate neighbourhood.

NOVÁK V., HRDINA J., and SMOLÍK J. Půdoznalecký prozkum pozemků hospodařské školy na Moravě a přilehlého okolí, Sborník vyzkumných ústavů zemědlěshých, sv. 14. *Ministerstvo zemědělstvi.* Prague, 1925.

The soil is that of a crystalline schist area. The Land Investigation Station at Brünn utilizes a large portion of the school fields for plant investigation. About 200 ha. were examined in detail. The summary of the investigation is seen graphically on the coloured map (scale 1 : 5000).

The soils are grouped as follows according to their genetic relationship.

1. Holocene meadow soils, 2. Podsol soils on diluvial drifts. 3) Podsol soils on gneiss detritus. 4) Podsol soils on diluvial deposits. 5) Podsol soils on disintegrated gneiss.

Further differentiation of these soils was carried out according to texture. On the average, the texture of the field mould was as follows :

Size of grain — mm.	Contents — %
0.01	40 - 45
0.01 - 0.05	20 - 25
0.05 - 2.00	40 - 30

A great lack of lime and of assimilated potash was determined by NEUBAUER'S method. L. SMOLIK.

Agricultural Importance of the Tocra District.

SCARTA, H. (R. Uff. Agrario della Cirenaica). *Rapporti e monografie coloniali del Governo della Cirenaica.* Series I, No. 7, 18 Tab., 1 Map. Bengasi, 1924.

From an agricultural point of view the soils of the Tocra district may be divided into argillaceous-sandy soils (along the littoral strip from Tocra to Bersis), fairly deep (even over 3 metres), with rocky subsoil (calcareous bed which forms its foundation) ; there are also soils of conglomerate type containing river-borne pebbles and rubble of superficial erosion.

Judging from appearances, they are fertile soils with high hygroscopic power ; this may be presumed with greater reason from the fact that they are soils formed of thousand years old deposits of mud brought down annually by floods.

The various alluvial strata which cover the calcareous bed have different depths at different points.

Considerably different in appearance are the soils in proximity to the Sebka, being composed of the finer elements of the alluvium : dusty in summer, swampy in winter, they have visible saline efflorescences which may become regular crystallisations. The saline concentration decreases gradually as one gets further from the lake basin of the Sebka. The approximate extent of economic territory considered by the writer is about 250 sq. km., of which about 85 % is utilizable for pastures, which are grazed at different seasons according to their position, and a proportion of 15-25 % utilized or utilizable for the growth of cereals.

The population of the Tocra hinterland may be calculated at 2952 souls, with a total of 30 904 head of cattle over a pasture area of 21 200 ha. The area cultivated under cereals varies very much from year to year according to the rainfall. In 1922-23, a year of copious and regular rainfall, it was 3720 ha., in the following year, a year of very irregular rainfall, it was only 85 ha.

The area made fit for irrigable cultivation is 158 ha. of which only 41 ha. are permanently cultivated ; the population which lives on and works this area is about 1/80th of the total population.

The growth of fruit trees represents a secondary item of income and the garden is more or less the result of the particular soil conditions and the social needs of the Kabyles and has become a factor of equilibrium and se-

curity against the sudden fluctuations of cereal and pastoral production.

There is some land which might well be irrigated, a total of 810 ha. forming a basis for the future increase in value of the zone.

There are too other lands which may be considered as subsidiary to the irrigable lands, and another 10 000 ha. of good land, with good depth and quality of soil, on gentle slopes, part of it benefited by winter floods.

No progress from the present form of misuse of the soil can be expectted from the indigenous population. Admitting the possibility of cultivating garden crops, part for local consumption and part susceptible of foreign and industrial trade, the establishment of a nucleus of a white population of about 2500 persons, to the extent of 5 per hectare, inclusive of white labour is considered possible.

Other groups might be established elsewhere with a total of 3500 for the land made fit for irrigable cultivation and about 7000 for ordinary dry cultivation, of whom not more than 3000 would be in Tocra and the others in rural villages scattered along the water places of Sabal.

The realization of this scheme, modest as it is, requires however shrewdness in the acquisition of land and in the investment of capital for irrigation and in general for economic reclamation. A. F.

On the meadows of the Tessin River. Study on the Connection of Soil Formation and the Succession of Plant Associations.

SIEGRIST R. and GESSNER H. Festschrift Carl Schöder. *Veroffentlichung des geobotanischen Institutes Rübel* in Zürich. Part 3. Rascher & Co. Zürich, 1925.

We heartily welcome this collaboration of botanists and soil experts. The present work shows very plainly how very closely soil formation and vegetation are connected with each other.

The investigation extends over the bottom of the valley of the Tessin from Airolo to Lake Maggiore. In the upper valley of the river the alluvial areas are only about 200 m. wide, whereas in the lower valley plains 10 km. long and 800 m. wide are quite covered with fertile woods and undergrowth. The following are the most interesting points for soil science.

All the soils examined belong to the brown earth type; the appearances of disintegration point to podsol soils, but these could nowhere be establised definitely. The unitary nature of the original deposits is shown by microscopic examination of the mineral composition of the sand. The new soils are bright grey, the more disintegrated older terraces showing pronounced chocolate-brown colouring, caused by humus and hydrate of iron. Analyses in muriatic acid extracts determined lime, humus and pH, ratio and suspension analyses gave the following picture of the soils: carbonate contents up to 12 %, humus contents up to 28 %. The very coarse sandy passage soils become very much richer in humus with progressive vegetation. Pronounced lime (and distinct magnesium) washing out is characteristic. The soils are found to be suitable for cropping, and quick cu'tivation of the meadows is recommended, to prevent the climatic washing away of its nutrient matter. H. J.

Sketch of Agricultural Geology of the Jura.

SIMONOT, F. *Le Jura Agricole*, 320 pages. Lons-le-Saunier, 1925.

We will confine ourselves here to the nature of the soils furnished by the different geological features of the Department of the Jura.

The generally marly soils of the Lias contain 4 to 15 % of lime, 2 to 3 % of phosphoric acid, and as much potash or nitrogen. They are very fertile.

The ferruginous limestone of Bajocien only yields on the surface soils containing traces of carbonate of lime, 2 to 3 per thousand of potash, and less of phosphoric acid and nitrogen.

The soils derived from the oolitic Bathonian limestones are chemically poorer. Carbonate of lime re-appeared on the analysis of the marly features. All soils of the middle and upper Jurassic are poor in phosphoric acid and contain less than 8 per cent of lime.

Lime content falls until there are only traces in the soils derived from yellow limestones, sands or the jagged face of the lower Cretaceus without the content in phosphoric acid being increased. The Pliocene soils of La Bresse do not contain any carbonate of lime and little phosphoric acid (0.5 to 1). The same is the case with ancient and glacial alluvial soils. The latter however are moderately rich in phosphorus, potash and nitrogen.

The richness of modern alluvial soils is very variable. In them the content in lime varies from zero to 20 per cent. The characteristic of Jura districts, where calcareous rocks predominate, is therefore the decalcification of the agricultural soils.

In view of the altitude of the mountainous part and the heavy rainfall, these lands are naturally suited for grass if they are marly and for forest if they are rocky.

Differing from dried regions showing the same features, Burgundy on the one hand and Provence on the other, which breed sheep, the Jura watered by 150 cm. of water goes in for the breeding of milch cows and manufacture of cheese.

The marls of the Trias and Lias exposed to the sun on the slope of the mountain are rich in phosphoric acid and potash and carry vineyards. Their content of carbonate of lime being less than 20 per cent., Riparia and Rupestris hybrids are used as grafting stock. The altitude of the vineyards is from 250 to 500 metres. DR. PIERRE LARUE.

On the Exchange and Active Reaction Figures of Some Moravian Soils.

SMOLIK L. O výměnných a aktivních reakóních číslech některých Moravských půd.

1. The following limits of exchange reaction figures in the Moravian soils were determined in pH :
   (*a*) With cultivated soils 4.4 - 7.4 ;
   (*b*) With forest soils 4.1 - 6.3.

Limits of active pH concentration :
   (*a*) Cultivated soils 6. 3- 7.3 ;
   (*b*) Forest and meadow soils 5.9 - 7.1.

The alkalinity of the soils fluctuates within limits not so wide as the acidity.

2. The greatest acidity (of smallest exchange and active pH concentration and at the same time the greatest titration acidity) was found in forest soils and in those cultivated soils only which came from the more humid climate (from 700 mm. upwards).

The profiles of the arid cultivated soils show neutral or weak alkaline reaction up to pH 7.3.

3. The profiles of the degraded black soil (e. g. Hulín) showed an approximately constant pH exchange reaction in the vertical direction. The argillaceous earth capable of exchange could not be established here (as with the majority of the arid soils); on the other hand lime capable of exchange occurred in the whole profile in considerable and constant quantity. The active pH concentration has a maximum in loose vegetable mould, a second in the deepest subsoil.

4. In all acid soils the presence of exchangeable argillaceous soil was established.

5. The titration acidity (n KCl) reached the following amounts (calculated to 100 g. dry soil):

(*a*) with cultivated soils, highest 3.927 mg H;

(*b*) with forest soils, highest 5.841 mg H; in water extraction 0.451 mg H.

6. There was no connection established between the weight of humus present and the pH concentration, though the soil samples whose humus was unsaturated (soils of more humid climate) showed everywhere a lower pH concentration.

7. In the laboratory test, the germinating capacity and average growth of barley showed no correlation with the different pH concentration (exchange and active) of the different soils on which the grains were grown.

8. The relation between the hydrogen-peroxide-catalysis of the soils and the exchange reaction figure in pH is only a partial one.

AUTHOR.

The Reaction Profile of some Old Valley filling Soils.

STEPHENSON, R. E. Soil Department Oregon Agricultural Experiment Station. Cornwallis.

Eight soils are studied to determine changes in hydrogen ion concentration, lime requirement, and replaceable calcium and magnesium with the development of a soil profile. Textural observations noted a marked concentration of colloidal clay material in the second major horizon in some of the soils studied. Replaceable calcium is usually much greater in amount in the heavy horizon than in either the surface soil or the parent material. In these cases acidity is greatest in the surface leached soil.

The development of a normal mature profile in the valley soils therefore appears to be accompanied by the formation of base poor, acid surface soil. The material from which the soil was formed, however, is usually

somewhat acid in reaction. The most fertile soils appear to carry the largest amount of replaceable calcium. Some of the soils which carry a fair amount of calcium in replaceable form are not productive however, apparently because of the physical conditions. X.

Relation of Replaceable Bases to Oregon Soil Problems.

STEPHENSON. R. E. Soils Department Oregon Agricultural Experiment Station. Cornwallis.

Replaceable bases are studied in eleven different Oregon soils taken from three types of climatic conditions. Six soils are taken from the humid valley section, two from the dry farm section and three from the arid section.

The soils from the humid area are heavy soil types acid in reaction, and much lower in total replaceable bases than soils from the dry farm section. One acid soil which responds abundantly to lime treatments in the field is very low in total replaceable bases, but especially low in replaceable calcium and high in replaceable hydrogen. The soils from the dry farm area are neutral in reaction, also rather heavy types, and very high in total replaceable bases and especially high in replaceable calcium. The soils from the arid section are neutral or only slightly alkaline light textured types. These soils are relatively low in replaceable bases, but show a high ratio of calcium to other bases.

There appears to be some correlation between total replaceable base and soil texture, as the heavier soils contain larger amounts when of similar reaction.

Calcium appears to be the most important replaceable base in both amount and function. Under humid conditions replacement of calcium by hydrogen produces base poor, acid soils. Under conditions of insufficient rainfall, calcium may be replaced by sodium, which results ultimately in alkali soils that are non-productive. In both cases prevention is decidedly better than cure. Proper soil management supplemented if necessary by treatment with special substances for its improvement may largely prevent either seriously acid or alkaline soils. At present there is no practical method known for reclaiming bad alkali soil. X

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General News.

Kíspatíc. — On the 17th May 1926, at Zagreb, the death occurred after long suffering of Dr. phil. MIJO KISPATIC, Professor in ordinary of mineralogy and petrography at the University of Zagreb, member of the Southern Slav Academy of Science, who had been living in retirement since 1918.

In addition to numerous scientific works which appeared in the " Rad der Südslawischen Akademie der Wissenschaft ", in the " Verhandlungen der K. K. geologischen Reichsanstalt ", in the " Centralblatt für Mineralogie ", etc., KÍSPATÍC was also the author, in the Croatian language, of a series of scientific nature instruction books, of which " Zemljoznanstvo, Zagreb 1877 " may be specially mentioned, as it represents the first technical instruction book on soil written in one of the Southern Slav languages. A. S.

Christensen. — On the 27th. August 1926 the death occurred of Dr. HARALD R. CHRISTENSEN, Director of the Statens Planteavls Laboratorium at Lyngby, Denmark.

Proceedings of the IV International Soil Science Conference.

The Proceedings of IV International Soil Science Conference — articles in original languages — edited conjointly by the International Institute of Agriculture and the Italian organizing Committee of the Conference, was published in book form last June and at once put in circulation.

The whole consists of 3 volumes containing 1758 pages, — tables and 183 figures and is a standard reference book on Soil Science. The general secretary — and acting president — of the International Society of Soil Science Dr. D. J. HISSINK has sent the following letter of thanks to the President of the International Institute of Agriculture, S. E. G. DE MICHELIS :—

" C'est mon devoir d'exprimer à votre Institut la reconnaissance de l'Association Internationale de la Science du Sol pour la participation qu'il a eu dans l'achèvement de cette grande œuvre, ce qui est une grande acquisition pour la Pédologie ".

A most careful index forming a valuable aid for its use has also been published.

Price of the three volumes	250	Lires It.
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Formation of the Italian Section of the International Society of Soil Science 19 July 1926.

At the last session of the Italian organizing Committee of the IV Conference of Soil Science, the President, Prof. G. de ANGELIS D'OSSAT presented the three volumes of the Proceedings of the Conference and expressed his thanks and those of the Committee to all who had collaborated in the interesting work. He drew special attention to the work of Prof. R. PEROTTI, secretary of the organizing Committee and of the Conference. A financial Statement was then made by Prof. PEROTTI and was approved.

On completion of the business and before declaring the meeting at an end the President, DE ANGELIS D'OSSAT, proposed the formation of an Italian Section of the International Society of Soil Science. The proposal was carried unanimously.

A provisional Committee of management was appointed to act until the meeting of a General Assembly. Its members were :—

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The above mentioned members are requested to send their subscriptions for the years 1925 and 1926 as soon as they see this notice.

In countries where there are national sections the subscriptions may be paid to the secretariat of these sections.

Dr. D. J. HISSINK

Acting President and General Secretary.

Erratum. — In the article by A. v. NOSTITZ, vol. II, 1 page 10, illus. 2, it should read " Increase of water-draining power " instead of " water capacity ".

Papers.

THE CONSUMPTION OF ARTIFICIAL FERTILISERS IN AUSTRIA IN 1925.

The use of artificial fertilisers in Austrian agriculture has increased greatly in recent years despite the generally unfavourable condition of the country and the neglect of this problem by the special agricultural government departments. It is due to the endeavours of farmers to repair their losses in the war by the most practicable increase in production. An appreciation of the possibility and of the necessity for agricultural progress is only found where education, that natural condition of growth, credit and market facilities are either good or at least bearable. Such advantages are met with in the Lower Austrian lowlands. According to information kindly supplied to the author by Dr. RUDOLF HAAS, head of the firm Heilgern and Haas of Vienna, 50-80 % of their total sale of artificial fertilisers goes to that part of the country. True, progress can also be observed in other parts of the country, but it is at present on a smaller scale, owing to the economical and technical difficulties met with in all attempts at intensification.

With regard to the origin of the artificial fertilisers used by Austria, the country produces about 45,000 q. of sulphate of ammonia, *i. e.* more than is used up annually by its agriculture. Since the spring of 1925 Austria has been capable of producing annually up to 500,000 q. of superphosphate, in the very modern works of the Wodawerke-Wetzler Co. Ltd. at Moosbierbaum. But the very uncertain economic and political situation of Central-Europe only permits of a very slow development of the scheme. All other kinds of artificial fertilisers, with the exception of a small quantity of so-called Reform phosphate, have to be imported.

The following tables give an account of the employment of the different kinds of artificial fertilisers in 1925 and the corresponding

consumption in 1924. The data are derived partly from official sources *e. g.* Austrian trade statistics, partly from private sources, especially from my collaborator Dr. HAAS.

1. *Nitrogenous fertilisers.*

	Quintals 1925	Quintals 1924
Sulphate of Ammonia:		
(*a*) Home production	35 480	32 640
(*b*) Imported	5 247	1 830
Total	40 727	34 470
Nitrate of soda	47 193	37 457
Calcium Cyanamide	55 091	35 315
Ammonium nitrate	5 687	3 710
Leuna nitrate	4 796	—
Total	153 494	110 952

2. *Phosphatic fertilisers.*

Superphosphate:		
(*a*) Home production	44,250	—
(*b*) Imported	325 327	284 409
	369 577	284 409
Thomas slag	324 328	343 123
Bone meal, slag phosphate etc,	80 000	60 000
Total	773 905	687 532

3. *Potassium fertilisers.*

Potassic salts	192 630	142 996

Thus it is seen that the employment of nitrogenous fertilisers increased by 39 %, the synthetic products being of the greatest importance. Of the phosphatic fertilisers superphosphate shows a 30 % increase, Thomas slag a slight decrease. The use of potassium salts shows a rise of 35 %. These figures justify great hope for the further development of the Austrian artificial fertiliser industry.

Bad Ischl. End of July 1926.

Dr. F. W. DAFERT
Wien.

THE CONSUMPTION OF ARTIFICIAL FERTILISERS IN DENMARK

The consumption of artificial fertilisers has increased very greatly of late as the following summary will show :

Annual Import of Artificial Fertilisers into Denmark in Million kg. (1).

Period	Nitrogen fertiliser	Phosphoric acid fertiliser	Potassium fertiliser
1871–1880	0.1	15.0	0.0
1881–1890	0.3	1[illegible].3	0.1
1891–1900	3.0	38.0	6.1
1901–1910	9.5	76.4	12.4
1910–1920	41.1	144.6	37.8
1921	105.0	80.2	14.6
1922	103.3	201.9	29.9
1923	123.4	231.9	42.4
1924	142.6	261.1	45.5
1925	174.5	288.1	47.5

The import figures correspond very closely to the actual consumption of the country, for apart from the change from raw phosphates to super-phosphates, there is no production of artificial fertilisers in Denmark worthy of mention, nor is there any export.

During 1924-25 the import of nitrogen, phosphoric acid and potassium fertilisers was divided between the separate fertilisers as follows :

I. *Relative consumption of the separate nitrogen fertilisers (% of total import).*

	1924	1925
Sodium nitrate	37.0 %	32.1 %
Calcium nitrate	50.3 ,,	44.7 ,,
Ammonium sulphate	11.3 ,,	22.5 ,,
Calcium cyanamide	1.4 ,,	0.8 ,,

The consumption of ammonium sulphate, which was small until 1923, has since shown a large relative as well as actual increase, while

(1) Figures taken from the report of the Danish Co-operative Fertiliser Co. 1925.

calcium cyanamide, which has never been used in large quantities in Denmark, has now almost disappeared from the market. Sodium nitrate is almost exclusively used in the form of Chile saltpetre.

II. *Relative consumption of the separate phosphoric acid fertilisers.*

	1924	1925
Raw phosphates	44.5 %	44.0 %
Superphosphates (about 18 % P_2O_5)	46.8 ,,	51.1 ,,
Thomas phosphates	8.4 ,,	4.9 ,,
Bone meal	0.3 ,,	0.0 ,,

Imported raw phosphates are not used directly as fertilisers, but exclusively as raw material in the manufacture of superphosphates. The amount of 18 % superphosphates produced is almost double that of the raw phosphate imported from which it is made. We may say that in 1925 about 95 % of the phosphoric acid fertiliser used for agricultural purposes in Denmark was in the form of superphosphates.

III. *Relative consumption of the separate potassium fertilisers.*

	1924	1925
37 % potassium fertiliser	92.1 %	95.4 %
Kainit and 20 % potassium fertiliser	7.9 ,,	4.6 ,,

The greatest consumption of potassium fertiliser was of the high percentage salt.

As the following table indicates, the relative prices between cereals and artificial fertilisers have varied during recent years in a direction favourable to agriculture.

Relation between prices of cereals and of artificial fertilisers.
(From the report of " Det Landøkonomiske Driftsbureau ").

Year	Average price of cereal per 100 kg. in crowns	Price of weight unit artificial fertiliser in relation to price of weight unit cereal		
		Calcium nitrate	18 % superphosphates	37 % potassium fertiliser
1909–14	12.83	155	48	93
1920–21	39.29	117	61	86
1921–22	26.31	131	50	87
1922–23	23.59	133	41	76
1923–24	25.39	134	36	67
February 1925 (1)	37.19	94	26	44

(1) From « Landbrugsraadets Meddelelser », February 6. 1925.

As a result of this development, artificial fertilisers are used on nearly all Danish farms at present. Based on a report of the Danish Co-operative Fertiliser Association, 1924, with statistics from 10,000 farms, we find that this year:

98 % of the Danish farmers used artificial phosphoric acid fertilisers
94 % » » » » » » nitrogen fertilisers
64 % » » » » » » potassium fertilisers.

The average consumption per ha. was:

Superphosphates	115 kg.
Nitrogen fertilisers	52 »
37 % potassium	16 »

We may say that what characterizes the consumption of artificial fertilisers at present in Denmark is the very large amount of phosphoric acid fertiliser used in proportion to nitrogen and particularly potassium fertiliser.

Statens Planteavls-Laboratorium, Lyngby, Denmark, 10 *August,* 1926.

Harald R. CHRISTENSEN.

CONSUMPTION OF CHEMICAL FERTILISERS IN EGYPT

For some time economic conditions have forced new practices on Egyptian agriculture, among others intensive manuring of the soil. To procure the fertilising materials which neither the live stock nor the natural resources of the country (*Tafla, Marog* or *Koufri*) any longer suffice to supply, the cultivator has recourse more and more to chemical fertilisers with whose use he was unacquainted 25 years ago.

The importation of these fertilisers did not really start before the year 1900, but in 1910 it already amounted to nearly 3600 tons; in 1914 about 75 000 tons, and in 1925 it has gone up to more than 258 000 tons. Such a rate of progress is, as far as we know, unexampled in the world.

We must recognise that the merit for this development belongs largely to the Royal Agricultural Society of Egypt, the principal importer.

It is this Society which has introduced these fertilisers and given instruction in their proper use, nor has it ever ceased to lavish its advice, based on exact experiment, on cultivators.

A list is here given of the quantities of various fertilisers imported into Egypt from 1902 to 1925.

As may be seen, *nitrogenous fertilisers* formed the greater part of the imports. This is because throughout the alluvial soils of the Nile nitrogen is the element which is most lacking, and the " limiting factor " of the crops. Of all nitrogenous fertilisers that which is most appreciated by cultivators and which is by far the most used is *Chile Nitrate*. In 1925, 173 764 tons of its were imported, representing 68 % of the total chemical fertilisers and more than 88 % of the nitrogenous fertilisers. It was moreover the first chemical fertiliser to be introduced into the country.

The other nitrogenous fertilisers imported consist of *cyanamide, sulphate of ammonia, nitrate of lime* and, for the last two or three years, *nitrate of ammonia, urea* and *Leuna nitrate* or *nitro-sulphate of ammonia*.

These last two are still in the experimental stage. However out

Imports of chemical fertilisers into Egypt 1902-1925
(in metric tons)

Years	Chile nitrate	Nitrate of lime	Sulphate of Ammonia	Cyanamide	Superphosphate	Other Fertilisers	Total
1902	—	—	—	—	—	—	2 152
1903	—	—	—	—	—	—	3 423
1904	—	—	—	—	—	—	4 791
1905	—	—	—	—	—	—	6 207
1906	—	—	—	—	—	—	12 725
1907	—	—	—	—	—	—	23 119
1908	—	—	—	—	—	—	11 521
1909	18 530	—	354	—	2 255	26	21 165
1910	30 505	—	1 660	—	3 318	76	35 559
1911	48 771	—	1 639	—	9 497	55	59 962
1912	56 047	—	1 650	728	11 459	205	70 089
1913	56 474	—	561	971	13 148	500	71 654
1914	52 325	—	2 633	771	15 278	1 603	72 610
1915	53 076	—	1 048	—	7 056	63	61 243
1916	19 350	—	2 620	201	3 250	11	25 432
1917	32 662	—	1 028	—	2 580	70	36 946
1918	2 888	—	173	—	—	10	3 071
1919	54 468	—	1 289	—	1 435	526	57 718
1920	98 889	—	3 431	430	13 772	3 724	120 246
1921	35 157	3 155	1 764	—	3 571	100	43 747
1922	97 350	7 597	2 758	25	10 378	99	118 207
1923	70 315	3 943	4 600	253	22 516	68	101 755
1924	121 835	7 956	4 955	—	43 146	1 195	179 087
1925	173 704	14 494	9 565	967	55 803	3 713	258 306

N. B. — The "Total" before 1910 was mainly composed of Chile nitrate.

The drop of 1916 to 1919, especially that of 1918, was due to special conditions during the Great European War (V.M.M.)

of the 3713 tons shown in the table of imports for the year 1925 under the heading " other fertilisers " 3000 tons are Leuna nitrate.

Most of the *nitrogenous fertilisers* are used for manuring winter cereals, *especially wheat.*

There is however an increasing tendency to use it for maize, the chief crop of the flood season.

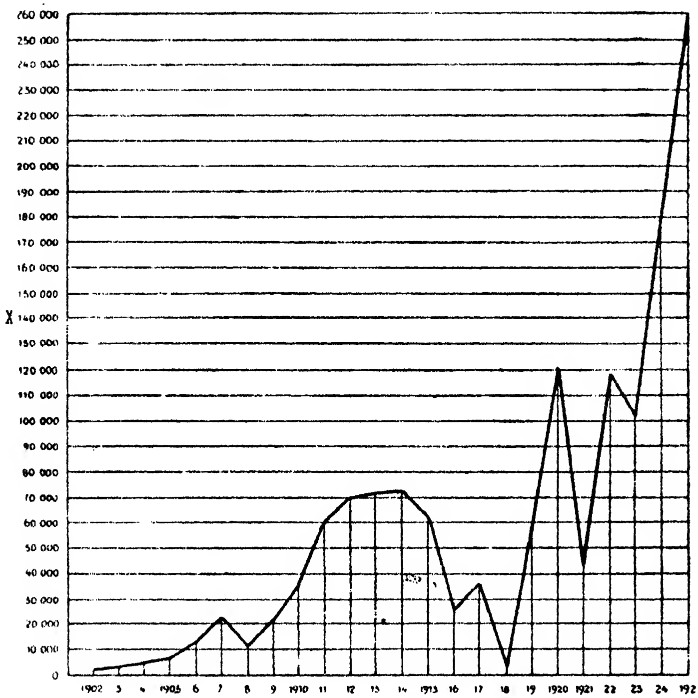

FIG. 121. — Import of Chemical Fertilisers into Egypt in metric tons.

As regards summer crops (sugar-cane, cotton, rice, sorghum, etc.), they only absorb a relatively small portion of it.

The following table, although it only relates to figures of sale of *Chilie nitrate* by the Royal Agricultural Society, figures which only constitute a fraction of the total sales, gives, we think, a fairly exact idea of the *relative consumption* of the various crops, while at the same time it illustrates the increasing use of chemical fertilisers in Egypt :—

Years	Summer crops (1) or *Sefi* crops	Flood crops (2) or *Nili* crops	Winter crops (3) or *Chétoui* crops
	Tons	Tons	Tons
1913–1914	2 272	4 216	20 836
1914–1915	2 406	4 673	27 901
1915–1916	5 249	5 916	13 466
1916–1917	6 762	5 601	18 482
1917–1918	4 687	8 986	16 944
1918–1919	462	28	5 803
1919–1920	3 329	8 224	26 091
1920–1921	9 696	13 575	22 187
1921–1922	2 167	9 434	20 575
1922–1923	3 781	10 190	25 593
1923–1924	11 069	15 213	24 213
1924–1925	11 231	13 993	25 931

(1) = Cotton sugar-cane and sorghum mainly. — (2) = Maize. (3) = Cereals, principally wheat.

Generally from 100 to 200 kg. of nitrate of soda, or the equivalent in other nitrogenous fertilisers, is given per *feddan* (1), according to the crops. The spreading is done, once or twice, either broadcast for winter cereals, or in mass at the foot of each plant, for maize, cotton, sugar-cane, etc. (2).

Formerly the cultivator distributed the farmyard manure at his disposal among the various crops of the rotation, except leguminous crops i. e. on cotton, wheat or barley, flax, maize, sorghum, sugar-cane) Now that the value of the land, and consequently rents, have considerably increased, there is an increasing tendency to reserve the farmyard manure and to give it to the maize in conjunction with nitrate; a little is also given to the cotton, while other crops receive only chemical fertilisers.

The following data are the averages obtained in the course of experiments made by the Royal Agricultural Society.

These figures, however, do not give an exact idea of the advantages of the new practice over the old one.

Compared with ordinary manuring with farmyard manure, that with nitrate of soda, for example, gives with *wheat* an increased yiedl

(1) The *feddan* measures 4200 square metres. It is practically the equivalent of one acre. (V.M.M.)

(2) For further details, see the special notices published by the Royal Agricultural Society (V.M.M.)

Yields in quintals per hectare.

Crop	Nature of the soil	North of the Delta		Centre of the Delta		South of the Delta		Middle Egypt	
		With Nitrate	Without Nitrate	With Nitrate	Without Nitrate	With Nitrate	Without Nitrate	With Nitrate	Without Nitrate
Wheat	Silicious-argillaceous soil.	18.85	10.50	—	—	26.36	17.90	—	—
	Black argillaceous soil.	18.40	15.14	17.92	11.28	—	—	107.3	4.71 (v. poor soil)
Barley	Silicious-argillaceous soil.	24.32	17.91	—	—	—	—	—	—
	Black argillaceous soil.	25.00	18.40	17.82	11.65	—	—	—	—
Maize	Silicious-argillaceous soil.	36.33	26.15	—	—	33.19	19.00	—	—
	Black argillaceous soil.	30.01	17.35	—	—	—	—	—	—
Rice	Black argillaceous soil.	37.47	32.42	—	—	—	—	—	—

of at least 150 kg. of grain and 250 kg. of straw per *feddan*, which at present prices means a net gain of £2 to £3.

The manuring of *maize* with chemical fertilisers, mainly nitrate of soda, practically unknown up to 1911, now absorbs nearly 20,000 tons of this fertiliser.

This crop, perhaps the most important in our list, offers a large market for nitrogenous fertilisers, covering as it does more than *two million* feddans yearly and being the most exacting crop in respect of nitrogenous manuring on account of its very short vegetative cycle and its place in crop rotation (after the summer fallowing during which nitrification is nil).

Up to 1911 the cultivators were in the habit of using most of the fertilising substances produced on the farm, always in insufficient quantities, for the maize, to the great detriment of the succeeding crops. Now they increasingly adopt the practice of giving it a combined manuring of farmyard manure and nitrate; the farmyard manure is buried before the sowings, to the extent of half the accustomed quantity and the latter is applied two or three times before the first or between the first and second irrigations, in quantities of 100 to 150 kg. per *feddan* in *takbich*, that is to say in packets at the foot of each plant. This combination of farmyard manure and nitrate has real advantages as regards yield and the soil itself. Compared with normal manuring with farmyard manure only, this combination produces an excellent average which varies from 300 to 600 kg. of

grain per *feddan* according to soils and the rotation. The financial advantage at present prices would be £2 ½ to £3 pei *feddan.*

As regards *séfi crops*, sugar-cane, of which about 60 000 *feddans* are planted annually, is the crop which consumes most nitrogen in the foim of *tafla, marog, koufri* or *nitrogenous fertilisers.* It is given up to 200 kg. or more of nitrate of soda or the equivalent in other nitrogenous fertilisers, which is applied usually once or twice as described above.

Cotton absorbs relatively little nitrogenous or phosphatic chemical fertilisers. It is mainly cotton crops of Middle and Upper Egypt which are given about 15 kg of nitrogen in the form of nitrate or other nitrogenous fertilisers (100 kg. of nitrate of soda). Cotton crops of the northern regions of the Delta, on soils *sufficiently freed from salt*, sometimes get the same quantity or half of it, according to the soils. The resulting surplus varies between one half and one *kantar* of lint.

Sorghum, flax and certain *market garden crops* are beginning to be consumers of chemical fertilisers.

As *phosphatic fertilisers*, only *superphosphates*, simple or concentrated, are used, but principally simple superphosphates containing from 16 to 18 % of phosphoric acid soluble in water or in citrate of ammonia.

At the present time from forty to fifty thousand tons of it are used annually.

Phosphatic fertilisers are mainly reserved for *bersim* (Trifolium Alexandrinum), the most important of the leguminous crops of the Egyptian rotation, and for beans ; a certain amount is applied to cotton.

200 kg is usually given per *feddan* (1).

Additional potash not being necessary for the normal soils of Egypt, scarcely any *potassic fertilisers* are imported.

In short, *at present* Egypt imports *mainly nitrogenous fertilisers* which are applied *principally* to *wheat, maize* and *sugar-cane*, all three belonging to the *Gramineae.*

Barley, cotton, sorghum as well as *rice, flax* and a few *market-garden crops* certainly absorb a certain quantity of them, but the practice of manuring these crops with chemical fertilisers is still in its infancy.

(1) For further details, see the special notices published by the Royal Agricultural Society.

Moreover, notwithstanding the progress made, Egypt, which produces an insufficient quantity of farmyard manure, still offers a large market for chemical fertilisers, especially nitrogenous fertilisers, principally for those with immediately and rapidly assimilable nitrogen. A simple calculation suffices to prove this.

As a matter of fact, the area occupied during the 3 agricultural seasons of the year by the different crops of the country amounts on the average to 8 million *feddans*. If we consider only the chief crops which might receive nitrogenous fertilisers with advantage, we get the following figures :—

Maize	1 900 000	feddans
Cotton in Upper Egypt	500 000	»
Sugar-cane	50 000	»
Wheat	1 450 000	»
Barley	350 000	»
Total . . .	4 250 000	feddans

without counting the market-garden crops, rice, sorghum, etc.

Allowing an average manuring per feddan of 100 kg. of nitrate of soda, the quantity susceptible of being absorbed by Egypt works out to some 400 000 tons.

Evidently only a relative value can be assigned to this limited figure. It is none the less true that Egypt is still far from consuming the quantities of fertilisers which its intensive cultivation and its soil relatively poor in nitrogen require.

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THE USE OF FERTILISERS IN SPAIN

Table of Production and Imports of artificial fertilisers during the years 1922-23-24-25.

Fertiliser		1922	1923	1924	1925
		Tons	Tons		
Natural Lime Phosphates	Imported	248,459	350,672	—	—
	Produced in Spain	—	5,397	—	—
Superphosphates	Imported	62,053	96,923	134,000	154,000
	Produced in Spain	—	608 830	750,000	800,000
Slag Imported		9,068	15,283	12,000	10,000
Potassic Salts	Imported	12,746	15,619	6,000	6,000
	Produced in Spain	—	—	—	18,000
Chile Nitrate Imported		46,107	92 602	135,982	120,639
Synthetic Nitrate Imported		6,789	11,328	12,529	12,000
Sulphate of Ammonia	Imported	77,214	84,828	—	—
	Produced in Spain	—	5,607	124,220	139,797

The 1923 totals merit attention, the total fertilisers available in that year being: Natural Phosphates 356 069 tons, Superphosphates 105 753 tons, Slags 15 283 tons, Nitrates of soda 103 929 tons, Sulphate of ammonia 90 434 tons, Potassic salts 15 618 tons.

Notes. — There is a noticeable increase during these years in the use of fertilisers, superphosphates being most employed, imports having fluctuated in the last two years from 17.8 to 11.5 % of the total amount used. The Spanish factories do not produce up to their maximum: in 1925 they may be considered to have only furnished 65.6 of their working capacity.

The amount of natural phosphates produced in 1923 is but small, only 5 397 tons, whereas imported phosphates amount to 350 672 tons. Since the working of the rich Spanish ores does not produce much phosphate, slags must be imported; they are however scarce on the market and cannot be used as much as would benefit the numerous lime-poor Spanish soils.

Fertilisers furnishing nitrogen in a nitric form are imported, as they are not produced in the country, Chile nitrate having in 1923

represented 88 % of the total amount consumed, the remainder showing the marked influence of synthetic nitrates. As to ammonium fertilisers an easing of the present commercial position might enable the formation of a synthetic N company using the Claude process, which would greatly increase the present small national output.

The consumption of potassic fertilisers is equally capable of expansion, since the discovery of layers of potassic salts in Catalonia will doubtless increase their use, especially if cheaper than the imported ones. The same applies to nitrogenous fertilisers, their present high price preventing them from being used as much as they might be, a high proportion of the sulphate of ammonia being absorbed in the Levantine zones, where they are intensely employed for the growing of fruit, vegetables and rice.

Superphosphates may be said to be used to a varying extent for all crops. The buyer of fertilisers has grown more confident since the Royal Decree of November 14, 1919 guaranteeing his rights.

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DEVELOPMENT IN USE OF FERTILISERS IN FRANCE

Cultivated soils generally contain all the mineral elements necessary for the nourishment of plants, but it is seldom that these elements are found in them in sufficient quantities to enable the plant to develop fully.

Moreover it is evident that soils become progressively impoverished in elements taken away in the crops produced.

It was in the middle of last century that, thanks to chemistry, our knowledge in this matter was made precise.

The use of chemical fertilisers, which has now become general, first started then. It consists in incorporating regularly in the soil nitrogenous, potassic and phosphatic products and in bringing in, in the form of lime or carbonate of lime, the calcium which is the fourth necessary element, of which moreover agriculturists have been too neglectful for some years, forgetting that it is useless to spread nitrogenous, phosphatic and potassic manures at great cost on a soil deficient in calcium. Doubtless the reason will be found in the high cost of lime, due to scarcity of coal, and that of marl, due to excessive cost of transport. The decalcification of soils is surprisingly rapid and agriculturists must realize that limings and marlings form the very basis of all rational manurings.

NITROGENOUS FERTILISERS.

The following table gives the annual position of our pre-war provision of nitrogenous fertilisers:

Products	Production in Tons T. = 1000 kg	Imports in T.	Total	Nitrogen content	
				Average	Total in T.
				%	
Nitrate of soda	nil	290 000	290 000	15	42 500
Sulphate of ammonia	75,000	20 000	95 000	20	10 000
Crude ammoniac	7,500	5 500	13 000	8	1 040
Cyanamide	7,500	500	8 000	15	1 200
Nitrate of lime	nil	9 500	9 500	13	1 235
Commercial nitrogenous fertilizers :					
a) Guanos, dessicated meat and blood, leather, horns, fish refuse, etc.	7,000	53 000	60 000	6	3 600
b) Glue residues, wool refuse, oil-cake, sewage, etc.	40,000	—	40.000	3	1 200
				Total . . .	70 775

The figure 40 000 tons for commercial nitrogenous fertilisers (*b*) is only given here as an indication, for want of precise statistical data.

No account was taken of farmyard manure, for like green manures, it is immediately restored on the spot to the very soil from which it is derived. We are considering only the products which bring into the soil, from outside, supplementary elements of fertility.

The above figures may be summed up as follows :—

Nitrogen produced	18 070 Tons
Nitrogen imported	52 705 „
Nitrogen consumed.	70 775 Tons

Nitrate of soda formed nearly two-thirds of the nitrogen consumed.

The law of 29th December 1923 authorized the Government to set up at the Toulouse Powder factory the manufacture of synthetic ammonia, corresponding to the fixation of at least 100 tons of nitrogen per day, or at least 30 000 tons a year.

Referring to the figures in the table above, it is seen that this production alone sufficed to reduce by over one-half our imports of nitrate of soda

It is to be hoped that our consumption of nitrogenous products will rapidly increase. In an important report on the question of nitrogen made on the 22 November 1922 by M. MATIGNON, Professor at the Collège de France, in the name of the Fertilisers Commission of the Ministry of Agriculture, he estimated the normal requirements of agriculture at 140 000 tons of nitrogen, or double the pre-war consumption. Consequently we ought to look for an increase and not a decrease in our nitrate imports in spite of the Toulouse factory, if the building of other factories were not luckily envisaged. One other factory is already working at Bethune where George CLAUDE'S process is in use. Other are in process of construction for the same process or by the similar Casale process.

Lastly we can expect a considerable increase in the production of cyanamide, which was unimportant before the war.

It is known that the synthetic manufacture of ammonia requires :—

1) the preparation in a state of great purity of both hydrogen and nitrogen ;

2) the mixture of these two gases, in the proportion of three volumes of the first to one of the second, then the passage of this mixture, previously compressed to 200 atmospheres (Haber process) or to 700 atmospheres (Casale process) or to 900 or 1000 atmospheres (C. Claude process) through a tube raised to a red heat, containing a catalytic metallic mixture (catalyser) which causes them to combine ;

3) the ammonia is produced and collected either in the state of gas (G. Claude and Casale) process) and fixed in the form of sulphate or hydrochlorate or transformed into nitric acid (used for making nitrate of ammonia) or lastly into urea.

The Toulouse factory will profit by all these and will make use of the Haber process in the manufacture of hydrogen and nitrogen but one or other of the two processes is the actual synthesis of the gases. From this brief account, it is evident that competition will soon become very active in the world's market for nitrogenous fertilisers between nitrate of soda, which has hitherto been completely master of the situation, and the new synthetic nitrogenous fertilisers, principally sulphate of ammonia.

But we have not yet reached the point where this rivalry will by competition bring about a decrease in cost favourable to agriculturists. Nitrate still dominates the market and on it are based the rates for all nitrogenous products. Now the purchase of nitrate is done in pounds sterling and the rates of freight are fixed in English money ; that is to say the price of nitrogenous fertilisers depends directly on the course of exchange.

In 1925, the French consumption of the chief nitrogenous fertilisers was :—

Nitrate of soda	280 000 T.
Sulphate of ammonia.	261 000
Cyanamide	58 000
Nitrate of lime	15 000

Deliveries of nitrate of soda keep up to pre-war figures. On the other hand an important increase is registered for the consumption

of sulphate of ammonia, which has gone up from 80 000 Tons in 1920 to :—

125 000	Tons in	1921
133 000	»	1922
153 000	»	1923
202 000	»	1924
261 000	»	1925

The supply of sulphate of ammonia was assured in 1925 by :—

117 000 T.	of French production
8 000	imported from England
145 000	imported from Germany on reparations account.

PHOSPHATIC FERTILISERS.

Superphosphates. — Phosphate of lime, of which there are important beds in Tunisia, Algeria and Morocco, should be made practical use of, transformed into superphosphate by treatment with sulphuric acid (100 kgs. of phosphate giving in this way 180 kgs. of superphosphate). Before the war, the French consumption of superphosphate reached 1 800 000 Tons, requiring 1 000 000 tons of phosphates.

In 1925, the quantity of phosphates imported reached 1,534,000 T. of which :—

1 012 000	Tons	came	from	Tunisia
377 000	»	»	»	Algeria
145 000	»	»	»	Morocco.

The development of the Morocco beds should be noted. They have exported 1921 8000 T., 1922, 80 000 T., 1923 190 000 T., 1924 430 000 T., 1925 721 000 T.

At present the superphosphate factories are largely supplied and are able not only to satisfy all agricultural demands, but even to export annually over 200 000 T. to foreign countries.

Ground phosphates. — The transformation of phosphates into superphosphates is costly and for a long time agriculturists have sought means of utilizing the natural phosphate directly. Experiments have recently been made in the stations of the Institute of Agricultural Research on phosphates ground to a condition of extreme fineness by various processes. But the results are not encouraging. Assimilibility does not increase with the degree of fineness as might

a priori be supposed, and moreover mechanical pulverization becomes extremely expensive when it is desired to get a certain degree of fineness. We may then conclude that normally the use of ground phosphates only gives good results in granite soils, such as those of the " Plateau Central " and of Brittany, in cleared land, and also in wet peaty grass lands ; moreover rather large doses must be used.

Usually superphosphates and dephosphoration slags are essential.

The pre-war consumption was about 100 000 T. a year. Reduced to 25 000 T. during hostilities, it has now returned to the pre-war figure. The beds of phosphated chalk of the Somme and the Yonne are ample for our needs.

Dephosphoration slags. — The manufacture of steel from phosphatic iron ores gives a slag in which all the mineral phosphate is found in the state of phosphoric acid readily assimilable by plants.

Before the war, about 400 000 T. of this fertiliser were used annually in France out of a production of 617 000 T.

French power of production has considerably increased since the war, owing to the restoration of the Steel-works of Lorraine and also to the occupation of the Sarre basin.

Our production of slags is thus more than double the pre-war figure : Germany on the other hand formerly a large exporter now finds her production insufficient for her own wants. French consumption had gone up in 1925 to 550 000 T.

POTASSIC FERTILISERS.

Before the war our consumption was estimated at 37 000 T. of pure potash a year, derived from seaweed

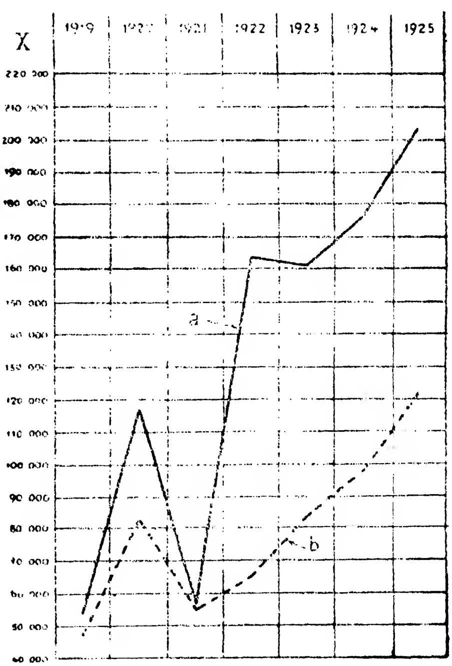

FIG. 122. — Production of Potassic Salts by Alsace mines : *a* = used in France, *b* = exported.

X = amount in metric Tons.

ashes, distillery ashes (*sugar beet*) and the mother-water of salt marshes, and partly imported from Germany.

Our actual requirements are much greater and all agriculturists deplore the parsimony with which potash salts were used by our farmers. The situation has greatly improved since the restoration of the Alsace mines, the production of which has also gone up considerably from 591 000 T. of salts containing 98 000 T. of K_2O in 1919 to 1,926 000 T. of salts containing 310 000 T. of K_2O in 1925. Sales in France have made similarly interesting progress, the consumption having gone up since the armistice from :—

1919	47 000	T.	of	pure	potash
1920	85 000	»	»	»	»
1921	55 000	»	»	»	»
1922	63 500	»	»	»	»
1923	81 000	»	»	»	»
1924	98 000	»	»	»	»
1925	122 300	»	»	»	»

SUMMARY.

French production and consumption have progressed very considerably on previous years.

The Administration, notably through its services of agricultural instruction, tries to inculcate a larger use of fertilisers.

Manufacturers, makers and importers particularly interested have decided to rearrange their propaganda with a view to obtaining better results.

Some years ago a propaganda syndicate was formed for developing the use of fertilisers in France, and this has already published a large number of tables, leaflets and notes conceived in a purely objective spirit, where all idea of commercial advertisement in favour of such and such a firm is rigorously prescribed. This propaganda, which cannot be too much encouraged, appears to give excellent results.

In conclusion, we may recall the interesting commercial events of the year.

REPRESSION OF FRAUDS IN THE MATTER OF FERTILISERS.

The passing of the law of 19 March 1925 which, by modifying Article 4 of the law of 4 February 1888, does away with the possibility of the vendor delivering his products with the stipulation of regulation of price according to the results of analysis.

This law strengthens the provisions of the law of 4 February 1888 relating to he obligation of the vendor of fertilisers to furnish the purchaser with all useful information regarding the nature, the origin of the said fertiliser, the content and origin of the fertilising elements which it contains, and the method of their combination. It makes it compulsory for the vendor to give to every purchaser a detailed invoice and requires him to affix to the packages a label giving the exact content in fertilising elements.

DEPHOSPHORATION SLAGS. — Prohibition of export restored for the months of September and October with the object of reserving for French agriculture a normal supply which large exports threatened to compromise.

POTASH. — Agreement concluded between the mines of Alsace and the Kali-Syndicat aiming at the suppression of competition between the two countries, increased production and trade outlets and fixing the share of sales in the world's markets.

NITROGEN. — Progressive development of the installation of synthetic nitrogen factories in various places and state of progress of works in course of execution at Toulouse.

PRICE OF FERTILISERS. — General increase in prices, more considerable for nitrogenous fertilisers, which, quoted in the world's markets in English currency, suffer directly from the effect of the depreciation of the franc. For phosphatic fertilisers, a less considerable rise, due to increased cost of production. For potassic fertilisers, a slight increase thanks to the policy of large output practised by the mines.

In 1925, the prices of the principal fertilisers varied as follows :—

Price per 100 kgs.	1st January 1925	31st December 1925
Superphosphates 14 %	20 to 22 F. per 100 kgs.	26 to 27 F. per 100 kgs
Bone » 16 %	36	43
Thomas Slag 18 %	15.65	18
Nitrate of soda	107	155
Sulphate of Ammonia	110	132
Cyanamide	82.50	93.75
Sylvinite 12 %	0.45 per unit	0.50 per unit
» 20 %	0.55 » »	0.60
Chloride of Potash	0.90 » »	1.00
Sulphate of Potash	1.50 » »	1.60

E. ROUX,

THE QUESTION OF FERTILISERS IN THE SOVIET UNION

The use of mineral fertilisers has hitherto been little developed in Russia. The cause of this is not the natural fertility of the soil — statistics show that the average yield per hectare is only half of the average yield in France and one-third of that in Germany, nor is it the ignorance of the peasants which prevents the use of fertilisers, but the cause is purely economic: the prices which the Russian peasant gets for his wheat are, as a general rule, much smaller than those ruling in Western Europe. It is impossible to wait until the level of prices in the interior of Russia may at an expected moment reach that of Western Europe, so persistent is the necessity of exporting wheat. This means that it is impossible to expect in the immediate future the same development in the use of chemical fertilisers in Russia observed in wheat importing countries. Cases as in exceptional years, such as 1925, of prices rising to an extraordinary height and falling again quickly after a short time, cannot sensibly alter the consumption of chemical fertilisers even during these exceptional periods.

Even if it were possible to forecast changes in prices one year in advance, during the preparation of the soil for winter wheat for example, it would nevertheless be impossible to give the chemical industry dimensions which would correspond to the conditions of an exceptional year.

We must therefore adopt a different scale for measuring our development of chemical fertilisers than would apply to countries of intensive agriculture, a scale suitable to their economic conditions.

As an example of this difference in conditions, it suffices to state that the price of wheat in Russia is ordinarily one-third of the price of nitrate. Obviously this precludes the use of nitrogenous fertilisers for cereals : it is only industrial crops, such as sugar-beet which repay the use of nitrate and that in very small quantities.

The use of potassic fertilisers is still more restricted. There are no beds of well determined potassic salts, but there are indications which render the existence of such beds probable. By a boring made recently near Solikansk (Ural) the presence of sylvinite was noted at a depth of 92 metres, but the question of extent can only be solved by further borings.

Conditions for the use of phosphatic fertilisers are relatively more favourable, and there are several beds of phosphates (though of very variable value) ; the soils need phosphate almost everywhere in the European part of the Union, except the steppe soils in the South-East. Certain difficulties arise in the question of phosphates owing to the geographical distribution of the raw material necessary for the manufacture of superphosphate. The beds of pyrites, for example, are found in the Ural, while superphosphate is most necessary for Western Ukraine, where the growth of sugar-beet is greatly developed. The pyrites has therefore to be transported two thousand kilometres or more.

Beds of phosphates are very common, but they are not always of such quality as to enable them to be used for the manufacture of superphosphate. According to M. SAMOÏLOV's estimate, the total quantity of phosphates contained in the beds in European Russia amounts to 5570 million tons. As regards richness in P_2O_5 an uneven distribution is observed between the following groups :—

Phosphates containing	Millions of tons	%
I. 24 % P_2O_5 and above	141.7	2.5
II. 18-24 % P_2O_5	1 708.3	30.6
III. 12-18 % P_2O_5	3 720.0	66.9
	5 570.0	100.0 %

In Southern Russia only in Podolia are there beds rich in P_2O_5, but quantitatively these beds are insufficient to assure the development of the chemical industry adequate to the wants of the Ukraine. The most abundant deposits are found in North-East Russia in the Ural between the Rivers Kama and Viatka, where not only the cultivation of beetroot but also the population is lacking in a land without railways or navigable rivers. In spite of all this, the manufacture of superphosphate is now being developed in the interior of the country, whereas before the war, superphosphates imported from abroad or made at Riga with imported phosphates or pyrites, were almost exclusively used. The following figures show the increase of production in recent years :—

	1923-24	1924-25	1925-26
Production of superphosphate	28936	57196	102600 tons (1)

(1) In the official sources the final figures relate to the period from the 1st October of each year up to the 1st October of the following year, for this reason the figures for the year 1925-26 are here given approximately.

These figures merely summarize the production of various factories.

Name of the factories	1923-24	1924-25	1925-26 (*)
	tons	tons	tons
Cernorecensk (near Nishny)	11 577	20 304	40 000
Kinechma	2 340	3 193	—
Perme	2 262	1 995	14 000
Vinniza (Podolia)	7 952	21 632	30 000
Ekaterinoslav	3 515	4 275	8 000
Odessa	1 290	5 376	10 000
Samara	—	420	—

(*) The figures in the last column are approximate. Figures are only given for superphosphates, because Thomas-slag is not now produced in Russia.

As has already been mentioned, the first object of the industry at its present state of development is to satisfy the requirements of the Ukraine in superphosphate for the growth of sugar-beet. The second task incumbent on it is the supply of Turkestan, for its cotton cultivation. With this object the scheme was for a factory of double superphosphate at Samara, but so far this has not materialised.

As a final but more remote goal a sufficiently large production of superphosphate might be obtained to reduce its price, so as to allow the general use of this fertiliser for ordinary crops, such as cereals and clover. The work of numerous agricultural stations records in most cases an energetic action of phosphatic fertilisers on the yield of cereals, especially in the black soil region which contains sufficient nitrogen. For example, the Agricultural station of Kharkov, after ten years of experiment, has obtained the following averages :—

	without manure	with supers.	with F. Y. M.	
	—	—	—	
Rye Crop	12.6	23.8	25.8	q. m.

Favourable results have been obtained in many regions, but the causes indicated above prevent the use of superphosphate as fertiliser for cereals : hence the use of phosphatic fertilisers cheaper than superphosphates becomes interesting. Under certain conditions (1) especially in the region of acid soils (podsols), it was long ago observed that ground mineral phosphate could replace superphosphate.

(1) See details in the author's book :— Düngerlehre, 1923. Paul Parey, Berlin (translation of the 5th Russian edition).

This practice, for example, existed under the Smolensk Government for 40 years (initiative of Prof. ENGELGARDT) : lately it has been ascertained that the black soil near its northern boundaries, where it has undergone a certain disintegration, is capable of reacting to phosphates not treated with sulphuric acid. These results have been noted in the Toula and Orel governmental regions.

Considering that for this object phosphates of inferior quality could be used, a start was made in exploiting the neighbouring beds at Kourek and Briansk, so as to decrease the cost of transport and deliver the phosphates at the lowest possible prices.

Methods were also sought to enable poor phosphates, so common in Russia, to be used for the manufacture of concentrated phosphates, containing phosphoric acid in assimilable combinations. The known methods leading to the production of double superphosphate and precipitates being too costly, the process of reduction and distillation of phosphorus under conditions corresponding with those of blast furnaces (M. BRITZLKE's method) for example, were studied. The preliminary researches and calculations have given very favourable results and experiments of manufacture on an industrial scale are now being tried. Differences in the natural and economic conditions and in the properties of phosphates and other raw materials render thorough research necessary, adapted to local needs of agriculture in the different parts of the Union. The work of research is divided among the 20 Agricultural stations and Colleges in the Union. In addition, there is at Moscow a Central Institute for fertiliser research, which includes three divisions (geological, technological and agricultural) and has at its disposal corresponding laboratories, plant houses and experimental fields.

The Institute's aim is to combine the work of various specialists for investigating the sources of raw material, finding suitable methods of manufacturing fertilisers and of their use under the actual conditions which determine the character of the country's agriculture.

The fertiliser Institute publishes its works in Russian with summaries in French, English and German.

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Abstracts and Literature.

General.

Determination of soil manurial requirements by the Neubauer method.

DENSCH. Erfahrungen mit Methode Neubauer. *Zeit. f. Pflanzenernährung und Düngung*, Vol. V, Part. B. Wirtschaftlich-Praktischer Teil, No. 2-3, pp. 97-104, February-March, 1926.

LEMMERMANN, O. Die Bestimmung des Düngungbedürfnisses der Böden durch Laboratoriumversuche. *Ibidem*, pp. 105-117 and pp. 133-143.

BLANCK, E. Beiträge zur Bestimmung des Düngerbedürfnisses des Bodens. *Ibidem*, pp. 118-125.

NEUBAUER, H. Die Bestimmung des Düngungbedürfnisses des Bodens durch Laboratoriumversuche. *Ibidem*, pp. 126-128.

In the papers quoted the writers refer to their experiments and the conclusions which they were able to draw from them on the NEUBAUER method, a method which NEUBAUER considers to be the only one giving an idea of the quantity of nutritive substances contained in the soil and soluble through the roots, and which, in contrast to the empiric methods hitherto adopted, should give a basis for the scientific investigation of the soil.

The investigators mentioned are of different opinions. DENSCH considers that there are many difficulties in the way of the introduction of the NEUBAUER method and that in its application the influence of light and perhaps also of temperature should be confirmed, while the application of laboratory results in open fields is always of questionable value, inasmuch as the figures obtained show disagreement between them not only as regards P_2O_5, but also for K_2O.

LEMMERMANN found that the same sample of soil, examined at different times, gave entirely different values of P_2O_5 soluble for the roots and it is a matter for further investigation whether such differences are due to the various influences of light, temperature or other local influences, or whether the sample of soil may suffer changes during the time it is kept. In any case the method is here at fault and it must be more thoroughly investigated and improved before being used for practical purposes.

According to BLANCK, the NEUBAUER method does not gives as satisfactory results as the method of relative solubility of the phosphoric acid of the soil in 0.5 % solution of citric acid. The differences which are established between NEUBAUER's method and growth experiments with oats indicate that it is an insufficient test, especially for borderline soils.

A test between the two methods, NEUBAUER's and the citrate method, has been made by LEMMERMANN. With the former, soils containing up to 6 mg. of P_2O_5 are indicated as needing manuring, between 6 and 8 as doubtful, above 8 mg. as not needing manuring. With the citrate method the limiting values were respectively 20 mg. ; between 20 and 25 ;

over 25. Results which were obtained with the same soils were however different.

LEMMERMANN then refutes NEUBAUER's assertion that this method differs from the others, which are purely chemical, in being founded on a physiological basis. According to LEMMERMANN no such contrast exists ; NEUBAUER's method takes little account of the laws of plant physiology while the so-called chemical methods are not exclusively so, but take into account in the preparation of the solutions the solvent power of the roots, and their use has been proved on the basis of practical research. This does not prevent NEUBAUER's method also, in the hands of an accurate worker who thoroughly knows all its difficulties and weaknesses, from being found useful, at least when it has been completed from a technical point of view. A. F.

The determination of soil manurial requirements.

GERLACH. Die Bestimmung des Düngerbedürfnisses des Boden. *Landwirtschaftliche Jahrbücher*, Vol. LXIII, No. 3, pp. 339-368. Berlin, 1926.

With the exception of peat soils most soils possess insufficient quantities of active nitrogenous substances and therefore need heavy manuring. The question is to find the proper amount of artificial fertilisers, of stable and green manure to add to the soil. Leguminous plants do not require nitrogenous fertilisers.

As far as most German soils are concerned, it is observed that they contain considerable quantities of potassic and phosphatic combinations which by themselves, or in conjunction with stable manure only, are sufficient to meet requirements for many years. Poor potash content is to be feared for peaty and light sandy soils ; potatoes, barley, meadows and pastures all need potash.

Some information regarding the phosphatic requirement of the soil may be obtained by the citrate method and NEUBAUER's method, but not the exact quantities necessary. Light sandy soils require phosphates which can be given to them by the addition of heavy soils in which phosphoric acid may be in a state of combination with iron or in the clay particles. Potatoes, meadows and pastures require phosphates.

The need of lime is connected with soil reaction and the new methods for its determination give sufficient indications regarding the necessity or inutility of giving lime.

The reaction of the superficial part of the soil is influenced by the artificial fertiliser used ; with a rational alternation of the latter, manuring with lime may be rendered superfluous.

The requirements of soils as regards other substances, such as silica and silicon chloride are still unknown.

On the whole however it must be said that we cannot previously determine the precise quantities of artificial fertilisers which are necessary in a year for a given soil, all the more so because such quantities depend largely on the rainfall which cannot be previously determined.

Our insufficient knowledge should not however lead to starving our plants and it is better to give too much than too little.

The old rule of first manuring abundantly with cheap potassic and phosphatic fertilisers and of then giving nitrogenous fertilisers during the period of growth still holds good.

The administration of sufficient quantities of fertilisers raises the total cost of production, but gives a larger and better crop and thus decreases the relative cost of production. A. F.

On the physiological reaction of fertilising salts.

KAPPEN, H. and LUKACS, M. Zur physiologischen Reaktion der Düngensalze. *Zeit f. Pflanzenernährung und Düngung*, Vol. V, No. 4, p. 249-270. Leipzig, 1925.

In the theory of the physiological reaction of fertilising salts, there are always some controversial questions ; above all the manner of the acid and basic physiological actions of these salts remains unexplained.

The writers' experiments are in fact aimed at clearing up several of the points at issue. They have first of all observed that maize can grow well in solutions of nitrate of ammonium, in spite of strong acidification, probably because of the amphoteric nature of this salt. Their researches also tend to show that potassic salts act as physiologically acid, the acidity however being not much less than that of chloride and sulphate of ammonium. Relating to this theory is the question of the state in which nutritive salts become absorbed by plants, whether that is to say undecomposed or in the form of ions. The latter hypothesis appears most probable, so that decomposition into ions would take place outside the plant itself. It cannot yet be stated whether the penetration into the cell of the molecules of the acids and bases takes place by absorption or by diffusion. A. F.

Fertiliser Investigations at Rothamsted.

Rothamsted Experimental Station, Report for 1923-1924, pp. 130, Harpenden, 1925.

Attention is drawn to the enormous loss from wastage of nitrogen contained in farmyard manure and artificial fertilisers, the value of which in Great Britain represents a sum not less than £8 000 000 or £9 000 000 per annum.

The results obtained from some of the fertiliser investigations were as follows :—

Sulphate of Ammonia : The average gains per acre from the use of 1 cwt. of sulphate of ammonia were :

	1922 Rothamsted	1923 Rothamsted	1924 Rothamsted Outside centres	Average of all soil and seasons to 1920	
Wheat (bushels)	3.25	—	—	4.3–6	4.5
Barley (")	5.5	4.5	8.16	3.5	6.5
Oats (")	—	8.3	—	—	7.0
Potatoes (cwt)	20	22–25	20	—	20
Swedes (")	20	25	5–9	30	20 N. Country 10 S. Country

The effect of doubling the nitrogenous dressing is to give a further crop increase ; in the case of cereals the increase is not infrequently more than double that obtained from the single dressing, as shown by the following data :

	No nitrogen	1 cwt. sulphate of ammonia	2 cwt. sulphate of ammonia	Increment in yield for 1st cwt.	Increment in yield for 2nd cwt.
1923 Oats (bushels)	29.2	37.3	46.5	8.1	9.2
Straw (cwt)	19	26	36	7	10
1924 Barley (bushels)	23.9	32.5	42.7	8.6	10.2

In the case of potatoes the second increment is usually less than the first, although the higher dressing is still profitable.

The time of application of the dressing is important for cereals, the later dressings being more effective than earlier applications, but for potatoes the application of sulphate of ammonia with the seed has been more effective than when given later as a top dressing to the young plants.

Barley : The results of three years investigations into the effect of manures on the yield and quality of barley, differ somewhat from the current teachings of agricultural science. It is usually recommended that the manuring for barley should be mainly phosphatic, nitrogen being given only after a corn crop and potash but rarely. Out of 30 tests this would have caused loss of money in no less than 26. The average reduction in yield in bushels per acre, consequent on the omission of each fertiliser during 1922, 1923 and 1924 has been :—

Decrease due to omission of :	After a straw crop	After roots fed off	After potatoes or beets (well manured)	Mean of all experiments
1 cwt. sulphate of ammonia	5.8	3.9	0.7	5.4
3 cwt. superphosphate	0.9	(0.5)	1.2	0.5
1½ cwt. sulphate of potash	(1.1)	1.3	1.1	0.3

(the figures in brackets are increases, not decreases).

The reasons for these results are probably : (1) Modern varieties of high quality barley are stiffer in straw and can carry larger crops of grain without risk of lodging. (2) Farmers give good dressings of superphosphate to root crops and sufficient of this fertiliser generally remains in the soil for the barley.

So far as the investigation has gone it suggests that farmers using a good modern variety of barley can aim at the highest crop that will stand,

and can use the appropriate fertilisers to secure this, without fear of loss in value.

A remarkable effect is obtained when the chloride of ammonia is substituted for the sulphate. In every instance the value of the grain has been raised and its nitrogen content lowered.

Basic slags and grass land: Examination shows that slags fall into two main groups: those in the making of which fluor spar is used: and those to which no fluor spar is added. The fluor spar slags are often less effective. Further, some slags were found to contain substances harmful to plants, or that to some extent counteracted the effect of the phosphate present.

Potatoes: Investigations carried out with various potash salts showed that the percentage of starch in the dry matter of all tubers analysed was higher with sulphate of potash than with any of the other salts.

Green Manuring: Experiments with mustard ploughed in on October 18, 1923, followed by winter oats, harvested in August 1924, were as follows :—

Basal manure	Yield of Oats After mustard ploughed in	(bus. per acre) after fallow (no mustard)	Increase due to Mustard	
			Bushels	Per cent
None	43.3	25.0	18.3	73
5 tons town refuse	51.8	27.1	24.7	91
10 " " "	49.3	30.6	18.7	61
Average	48.1	27.6	20.5	74

Leguminous Crops: Pot experiments showed that unrotted straw greatly increases the number of nodules formed on each clover plant, but there was no increase of yield until phosphates were added.

It was also found that many leguminous plants fail to grow unless supplied with traces of boron. W. S. G.

Necessity of manuring in the State of São Paulo (Brazil).

COELHO DE SOUZA, William W., A fertilidade natural de nossas terras. *Ceres*, Vol. II, No. 1, pp. 174-176. São Paulo, 1926.

Generally prejudice prevents the use of fertilisers in the tropics, but this is not always so, seeing that the chemical composition of the soil varies tremendously just as in European and temperate countries of other continents.

In the State of São Paulo not all the soils are rich in nitrates, on which account artificial nitrates are required, especially where for centuries the same crop has been grown or products for export trade to the other States in Brazil.

Chemical analyses of various soils of the State of São Paulo have often indicated the almost total absence or scarcity of nitrates necessary for profitable agricultural production.

The habit of burning the forests to obtain land free from trees for cultivation transforms the mineral substances of the surface of the soil, which the heavy rain then washes away, leaving the soil sandy and deprived of the substances required by the crop.

It is known that after some years not a little of the unmanured land of the State of São Paulo can no longer produce rice, maize, cotton, or sugar-cane.
E. M.

The influence of artificial fertilisers on the structure of the soil.

RENNER, W. (Agrikulturchemisches u. bakt. Institut der Univers. Breslau). Der Einfluss verschiedener Düngesalze zumal von Kalk und Phosphaten auf die Struktur des Bodens. *Zeit f. Pflanzenernährung und Düngung*, Vol. IV, No. 10, p. 417-451, 16 tab. Leipzig, 1925.

Oxide of calcium, added to soils, usually has a decidedly favourable effect, in the way of helping flocculation. Carbonate of lime acts similarly but to a lesser extent.

Thomas slag and Rhineland phosphates cause considerable alterations in the physical properties of soils only when given in large quantities. The action of sulphate of calcium is slight and, in some cases, rather unfavourable. Superphosphates act similarly, and in no case cause flocculation.
A. F.

Pasture Top-Dressing in New Zealand.

WARD, F. E. and HUDSON, A. W. *New Zealand Journal of Agriculture*, Vol. XXX, No. 6, pp. 393-402, Tables 5. Wellington, 1925.

In many parts of New Zealand top-dressing of pastures has been carried out for many years, but under the conditions of Canterbury, with light rainfall and short-rotation pastures, top-dressing has not generally been practised.

Experiments were carried out in 1923 and 1924, the manures being selected to test soluble phosphates (super) against the less soluble phosphates (basic super), and to note the effect of dried blood used in conjunction with these phosphates.

From data obtained the following conclusions were drawn:—

In all cases except that of basic super and dried blood, the cost of manures was more than paid for by the increase in one crop of hay. The use of dried blood for top-dressing of pastures cannot be recommended.

The crop increases due to the second application of manure were not so great as those due to the first dressing.

The manures increase the palatability of pastures.

The increased development of clovers was considerable.

W. S. G.

The action of alkaline chlorides on plants and soil.

DUPONT, C. (Station agronomique de Nancy). Action exercée par les chlorures alkalins sur les plantes et sur les sols. *Ann. de la science agronomique française et étrangère*, Vol. 41, No. 6, pp. 369-391. Paris, 1924.

The use of chlorides as fertilisers tends to increase and agriculture uses sylvinites largely because they have the advantage of containing very

available potash at low cost, while chloride of ammonia places nitrogen at the disposal of cultivators under good conditions.

This use of chlorides as fertilisers, which is expected to increase, has been objected to, and certain consequences of the application of sylvinite and attributed to the action of chlorine have caused a certain distrust. For this reason the writer has thought it well to make experiments to see whether any toxic action can really be attributed to the chlorine.

The yield of wheat did not decrease with a dose of kg. 3350 per hectare, and the same held good for flax, with which however such a quantity, given in the form of chloride of sodium, exercised a slightly toxic action absent when given in the form of chloride of calcium.

The yield of mustard increased with kg. 1300 per hectare, decreased with double that quantity: lupins stood the former quantity well, disappeared with the double dose. Very sensitive were vetches and buckwheat, which were destroyed respectively by doses of 1700 and 870 kgs. per hectare.

On germinating seed chlorine has a decidly toxic action, to which wheat is more resistant. The addition of chlorine increases the quantity of this element contained in the plants, in an unequal manner varying with the various plants, without there being any absolute relationship between the quantity of chlorine absorbed and the toxic action exercised. In alkaline soils alkaline chlorides diminish the alkalinity of the soluble potash, but when the soil is poor in potash and the alkalinity of the soluble potash is therefore reduced, the contrary effect is produced. The diminution of the alkalinity of the soluble potash, under the influence of the chlorides is only apparent and is due to the precipitation of lime from the chloride of calcium existing in the plant by the carbonate of potassium formed during calcination. In the soil, the transformation of chloride of potassium into chloride of calcium depends absolutely on the soil's absorption power. Such transformation is almost integral in clay soils and is on the other hand scanty in sandy soils, poor in colloidal elements. Chloride of sodium undergoes such transformation in a lesser degree because the soil's power of absorbing is less.

Calcium salts have little effect on the absorption of potash, while they have considerable retarding action on that of sodium; hence they cause the formation of chloride of calcium to decrease at the expense of that of sodium.

If, as in the case of sylvinites, chloride of potassium and of sodium are introduced into the soil, the chloride of calcium, formed at the expense of that of potassium, prevents the transformation of chloride of sodium and lessens the decalcification which might occur by reason of this salt.

For the useful employment of sylvinite the following dangers should be avoided :—

1) The toxicity of the chlorides (application must be a long time before seeding).

2) The losses in drainage water, results of incomplete absorption of potash by the soil (surface application in spring).

3) Enrichment in sodium of the argillaceous colloids of the soil

and the resulting decalcification and bad physical condition of the soil. Such drawbacks are not to be feared in soils containing a sufficient quantity of lime and in a good state of chemical activity, while they may be found in soils lacking carbonate of lime, badly manured or when using excessive quantities of poor sylvinite. A. F.

The influence of a complete mineral fertiliser on the growth of wheat.

CHAUSSIN, J. Etude du milieu intérieur et des tissus insolubles ou cours du développement du blé. Influence d'un engrais minéral complet. *Ann. de la Science agronomique franç. et étrangère*, Year 42, No. 2, pp. 124-144, 5 fig. Paris, 1925.

Manured wheat, with more rapid growth and higher yield, has higher osmotic pressure in the leaf and stem and a larger proportion of mineral matter in the soluble portion of the leaf than unmanured wheat.

The leaf, which is the principal laboratory of the plant, except during its primary growth and important migrations at the end, shows a remarkable constancy in the composition of its internal sap. The large proportion of mineral matter which is found in the soluble part of the leaf and which may be as much as 20-30 and even 40 %, is a fact which should claim attention from the point of view of the function of these mineral substances in the hitherto obscure mechanism of assimilation

It appears that the Gramineae have a lesser faculty than other species (leguminosae) of abstracting the necessary mineral substances from the soil. A. F.

The growth of various part of plants under the action of different stimulants.

JACOBI, H. (Biolog. Versuchsanstalt der Akad. der Wissenschaft in Wien). Beeinflussung des Wachstums morphologisch ungleichwertiger Pflanzenteile durch verschiedene Reize. *Oesterr. Botanische Zeit.*, Vol. LXXV, No. 1-3, p. 29-42, 4 fig., bibl. Vienna and Leipizg, 1926.

It is known that the winter rest of woody plants may be shortened by the action of known stimulants. Also certain parts of the plant which do not remain attached to it, but which contain reserve materials, may be brought to a certain stage of development by the action of such stimulants; this happens, for example with pollen and seeds.

The writer's researches have in fact shown that some salts in determined concentrations (solutions of chlorides of potassium, calcium, sodium and magnesium) are able to cause resting parts of the plant to develop. Concentrations of a slightly weaker strength than N/1000 are active for the development of the pollen of *Impatiens Sultani* in the absence of sugar; greater dilution (for example, 1/10,000) has no effect.

Chloride of magnesium does not cause any activity, that of manganese retards development. Pollen tubes growing in solutions of chloride or nitrate of potassium also show a strong protoplasmic current.

With the same solutions it is possible to cause the development of buds and leaves of *Siringa vulgaris* and to accelerate the germination of seeds of *Phaseolus vulgaris*. With *Siringa vulgaris* and *Impatiens Sultani* the most noticeable action is caused by potassium salts.

Buds of *Siringa vulgaris*, which during the resting phase, in darkness, do not germinate, may be caused to develop by being punctured or injected with distilled water or solutions of potassium salts. A. F.

The Influence of Aluminium, Manganese and Iron Salts on the Growth of Sugar Cane, and their Relation to the Infertility of Acid Soils.

McGEORGE, W. T. *Experiment Station of the Hawaiian Sugar Planter's Association*, Bulletin. No. 49, pp. 95. Tables 18. figs. 33, bibliography. Honolulu, 1925.

The author gives details of an investigation as to the cause of the low fertility of acid Hawaiian soils, the tonic action of certain acid salts, particularly those of aluminium, being especially studied.

The conclusions reached were as follows :—

(1) Salts of aluminium in concentrations which are present in many acid Hawaiian soils have a retarding action or even a severe toxic action on the growth of sugar cane.

(2) Manganese salts have no effect on the root growth of sugar cane in water cultures.

(3) Acidity *per se* or hydrogen ion concentration of the intensity present in most of the soils examined has no influence on the growth of cane. It is the aluminium salts present in such soils that retard growth.

(4) Aluminium toxicity is a direct toxic action, and not a phosphate deficiency, although increasing the phosphate or potash reserve increases the plant's resistance.

(5) Cane plants grown on acid soils containing soluble iron and aluminium have abnormal accumulations of those elements in the nuclei surrounding the xylem cells at the nodal joint of the stalk.

(6) Acid soils containing aluminium respond markedly to soluble phosphates, also to heavy applications of potash.

(7) Lime gave little or no immediate response.

The investigations show that aluminium is a factor directly associated with the retarded growth of sugar cane on acid lands ; also, that both potash and phosphate may exert an influence other than as a direct plant food. W. S. G.

Influence of Fertilisers in Protecting Corn against Freezing.

MAGISTAD, D. C. and TRUOGE. *Jnl. of American Society of Agronomy*, Vol. 17, No. 9, pp. 517-526, Bibliography. Geneva, N. Y., 1925.

It is well known that the greater the concentration of dissolved materials in a liquid, the lower is the temperature at which the liquid freezes. Hence, if the application of fertilizers increases the concentration of dis-

solved materials in the plant sap, then such application should lower the temperature at which the plant freezes.

The authors' investigations showed that application of fertilizers in proximity to the plant increases the osmotic pressure of the sap of young maize plants, and lowers the freezing temperature of the plant from one to two degrees Centigrade, which is often sufficient to prevent maize being frozen by late spring frosts. Owing to this action there is an additional reason for the use of fertilizers in northern latitudes, for certain crops which are grown on soils subject to late spring frosts. The greatest benefit in this way, from the use of fertilizers, will occur on peat soils, poor sands and other soils of low soluble salt content. W. S. G.

Manual of Agrarian Chemistry.

PROTOLUNGO, U. One Vol. in 24 (mm. 100 × 150) of 524 p., 10 fig., 20 diagrams, U. Hoepli ed. Milan. 1925.

The contents of this manual are fundamentally limited to pedology and the doctrine of the fertilisation of the soil. Real and proper plant chemistry is therefore not dealt with in it. Considering, however, that pedology and still more the doctrine of soil fertilization are closely related to plant physiology, the first five chapters are on physiological plant chemistry. He then proceeds to investigate the soil from a lithological, physical and chemical point of view, alluding now and again to microbiology and enlarging specially on the relationship between the qualities of the soil and the vegetation. The second part is devoted to the fertilisation of the soil and he considers improvement devices and correctives, nitrogenous, phosphatic, potassic and mixed fertilisers, their production and use.

In separate chapters Italian soils are described and statistical data on Italian production and consumption of fertilisers are referred to.

A. F.

S o i l I m p r o v e m e n t m e t h o d s .

The rate of solution and action of calcareous fertilizers.

MANSHARD, E. Orientierende Untersuchungen zur Frage der Losung-bezw. Wirkunggeschwindigkeit verschiedener Düngekalkformen. *Zeit. für Pflanzenernährung und Düngung*, Vol. VII, No. 1, p. 31-53, 5 fig., 2 tab., Leipzig, 1926.

The experiments were made with :—

1) Calcareous lyes, containing 8.51 % of chlorine and 25.09 % of Lime, of which 13.68 % in the state of CaO ; 2) marl ; 3) cretaceous limestones.

It appears on the whole that none of the products used, even in strong doses of 100 q. per ha., have given noteworthy effects. Although the lime was dug in to a depth of 6-8 cm., the reaction of the zone at 10-20 cm. remained acid, and even strongly acid. Even the calcareous lyes did not show any superiority from this point of view over the marls and limestones, moreover the presence of chlorides in them acted in an unfavourable manner.

The cretaceous limestone, notwithstanding its coarser degree of pulverization, has a more rapid neutralizing effect than marl. It also seems that the structure of the various calcareous products is of considerable importance. A. F.

The transformation of quick-lime in the soil.

SCHEFFER, F. (Institute of Agricultural Chemistry of Göttingen). Ueber die Art der Umwandlung des Aetzkalkos im Boden und ihre Ursachen. *Journal für Landwirtschaft*, Vol. 27, No. 4, p. 201-235. Berlin 1924.

In soils poor in carbonate of lime and also in those with a neutral reaction, the transformation of CaO into $CaCO_3$ does not appreciably take place, inasmuch as a large part of the CaO becomes otherwise combined. Such a change on the other hand noticeably takes place in soils rich in $CaCO_3$. In the others the quantitative course of the transformation becomes retarded by substances which act as absorbents. As such may be mentioned gelatinous silicic acid and the mixture of gelatinous $SiO_2 + Al_2O_3$. Gelatinous SiO_2 has also the power of decomposing $CaCO_3$. A. F.

Organic Manures.

Farm-yard manure fermentation.

WEIGERT, J. (Landesanstalt f. Pflanzenbau und Pflanzenchutz: München). Mitteilung über den derzeitigen Stand und die bisherigen Erfahrungen bei der Gärdüngerbereitung. *Zeit. f. Pflanzenernährung und Düngung, Wirtschaftlich-Praktischer Teil*, Vol. V, No. 4, p. 144-161. Leipzig, 1926.

LEMMERMANN O. (Landw. Hochschule u. Landw. Versuchstation f. Brandeburg u. Berlin). Das Verfahren der sogenannten Heissvergärung des Stalldüngers. *Ibidem*, p. 162-168.

This patented process by which is obtained the so called "*Edelmist*" (noble dung) is carried out as follows :— The manure is placed in small square based heaps 60 to 90 cm. high and never pressed down. The internal humidity ordinarily reaches 75 %. The heaps are covered with old tarred roofing felt and the mass is allowed to ferment. When the temperature has reached 60°-75°, which is generally found to be the case in a couple of days, the heap is strongly pressed down on the ground and another heap is placed on top of it, when it is then left for at least 4 months. The aim of compression is to arrest bacterial life, though obviously this is not achieved, since this goes on evenly and, as happens in the ordinary heaps of manure, only diminishes gradually.

Among the advantages attributed to the method is the killing of the denitrifying germs. This is not confirmed by LEMMERMANN's researches, not would it be of importance in any case, since such germs are found in all cultivable soils.

It is asserted that this "noble dung" contains nitrogenous combina-

tions more easily utilizable by the plant. From the comparative researches carried out it appears that its action is about 30 % of that of sulphate of ammonium, which corresponds with the action of common stable manure.

It would be useful to know the quantity of organic matter and nitrogen lost with this process in comparison with the common method ; it appears that the losses are greater using the special method. As regards chemical analyses, it should be observed that there are such differences in the various analyses of this product as to prevent any conclusion being drawn from them.

Practical tests of manuring have been slightly in its favour ; it should however be taken into consideration that the common manure used for comparison was not of very good quality and consequently it is necessary to repeat the experiments on a large scale.

The subject matter of its advertisements is also based on the possibility of its giving the soil a carbonic manuring, the very possibility of which is of too controversial a nature to allow it to be of any value.

In conclusion, this m thod is worth serious consideration, but needs further research before a definite opinion on its merits can be reached.

A. F.

The value of stable manure in Brazil.

FERREIRA DE CARVALHO, J. Adubo de curral. *O Agricultor*, Year IV, No. 6, p. 10. Lavras Minas (Brazil), 1925.

Hitherto no " fazendeiro " has considered stable manure as important, and consequently it was not used as fertiliser, while the cultivated land became impoverished and the crops decreased. As the Brazilian farms (" fazendas ") are almost always mixed, that is to say also rear animals, it is very easy to restore to the soil 80 % of the substances derived from it, which then return to the cultivated plants.

Stable manure compared with other fertilisers proves better in most cases.

A cow of 300 kg. produces on the average 8540 kgs. of solid excrement which contain :— 42 kgs. of nitrogen, 21 of phosphoric acid and 42 of potash, elements which have inclusively a value of 269 paper " milreis " (equal to 358 sh. at par values). Considering the high prices of chemical fertilisers in Brazil this is no negligible value. A farm which has fifty cows will so produce a large and valuable amount of manure, which owing to faulty or non-existent storage has hitherto been lost.

An easy method of keeping stable manure consists in making a trench of size suitable to the amount of dung produced and with a cement bottom to prevent loss of the liquid portion by infiltration into the soil.

The first layer put into the trench is dung, on top of it a thin layer of peat ; on top of the peat is placed another layer of dung and then a layer of straw, and the trench is suitably coverd to prevent entry of rain water. Once the trench is filled with stable manure, this is left to season, after which it is taken out and mixed up. For each " alqueire " (one " alqueire " = 11.96 acres) 40 to 50 tons of stable manure are required every 5 or 6 years.

M. E.

The utilization of Algae and marine plants.

DESCHIENS, M. Les utilisations des algues et des plantes marines, *Chimie & Industrie*, vol. 15, No. 55, pp. 675-698. Paris, 1926.

In Europe especially in France, England, Ireland and Norway the variety of seaweeds which are met with is almost always the same; the commonest species are Laminaria *saccharina*, *Cloustomi* and *flexicaulis*, the Fucaceae and *Choudrus Crispus* or Caragheen Lichen. In the United States, the coasts of the Pacific Ocean (California) are particularly rich in huge Laminarias which often attain a size of hundreds of metres. In Japan grow algae specially suitable for food. Among marine plants other than algae should be mentioned the Zostera. From the earliest times the coastal populations have gathered the algae and marine plants of the coast for manuring their land. These roughly dried, broken in pieces and heaped together, begin to ferment and are then capable of being used as fertilisers. Zostera may be used as litter for animals.

The Laminarias are most in request for the manufacture of iodine. Industrially it is estimated that, to obtain 10 kg. of iodine by incineration, it is necessary to treat one ton of seaweed ash. This ton of ash corresponds to 5 tons of sundried seaweed and to 25 tons of fresh seaweed. In 1911 the world's production of iodine was 750 t. of which 175 went to Europe, 75 to Japan, and 500 to Chile for the nitrate industry. Among the numerous industrial and agricultural uses of Laminaria the most important is as a source of iodine and of potassic fertilisers; in addition we have the Algin industry and alginates and derived products, the pharmaceutic uses and their use in the textile industry (printing and stiffening), the use of caragheen lichen, the agricultural use of various seaweeds as fertilisers and lastly the utilization of Zostera (" varec ") as substitute for straw in the furniture industry.

During the last few years a great volume of scientific and industrial research regarding the diffierent products of seaweeds has been developed, and especially the extraction of iodine has been widely studied. The more common method of burning the seaweed to extract potash and iodine was rather rudimentary, being based on primitive methods which caused a considerable loss of useful products. Various attempts to avoid this waste have been made by many investigators who undertook the treatment scientifically by means of carbonization in closed vessels, obtaining as by-products combustible gas, tar and coke.

In the process of incineration and carbonization the organic matter is completely lost, which constitutes a grave defect from an industrial point of view. An attempt has therefore been made to extract the iodine and to utilize afterwards the organic matter either as food or in the state of algin.

The industrial processes aim in the first place at effecting a methodical lixiviation of the dry seaweeds with pure water or water slightly acidulated to free these seaweeds from the large quantities of salts. The demineralized organic product is, afterwards, either dried and cut in pieces for use as food for animals, or placed to steep in a solution of

carbonate of soda for the extraction of algin, a mucilaginous substance used for the manufacture of alginates and derivatives.

Many other experiments have been made. In the United States fermentations tests were made to obtain acetic products.

However, in order that the various processes should become industrial and assure an economic profit they must be the object of further scientific research and study especially from a chemical point of view.

Green Manuring for Sugar Cane.

DODDS, H. H. (Director, Experiment Station, Natal). *Planter and Sugar Manufacturer*, Vol. LXXV, No. 14, pp. 269-272. New Orleans, 1925.

Attention was drawn by the author to the exhaustion of the soil organic matter after continuous growing of sugar-cane, particularly where the practice of burning the trash has been followed.

The yield of cane in Louisiana has steadily fallen from 18 tons per acre to 7 tons, the chief cause being the decrease of soil fertility. To meet the deficiency a crop of cowpeas (*Vigna* sp.) was ploughed in before planting cane ; the cane was grown for two years in succession.

If the nitrogen balance be studied it will be found that about 136 lb. of nitrogen per acre are required for the two crops of sugar cane, and the cowpea crop cannot supply more than 78 lb., hence there is still a loss of 58 lb., to which must be added 34 lbs. for the nitrogen in the following crop of maize.

In Louisiana, the cane is planted in October, and it was found that the nitrogen deficiency could be met, without altering the rotation, by sowing *Melilotus indica* on the cane during the same month. The green crop was ploughed in before cultivation of the cane in the spring, and added about 100 lb. of nitrogen per acre to the soil, equivalent to 700 lb. of sodium nitrate.

The average yield of cane increased from 10 to 14 tons per acre, or an increase in value of £ 5 for an outlay of 14s. Further, soil exhaustion was checked. The author gives brief notes on plants which may be grown for green manuring, such as : Velvet beans (*Stizolobium*), Mauritius bean (*Saterrimum*), Cowpea (*Vigna* sp.), mung bean (*Phaseolus aureus*), Sunn hemp (*Crotolaria juncea*), yellow sweet clover (*Melilotus indica*), lupins, buckwheat (*Fagopyrum* sp.). W. S. G.

Green Manuring in India.

JOACHIM, A. W. R. *Tropical Agriculturist*, Vol. LXV, No. 6, pp. 325-331, Bibliography. Peradeniya, Ceylon, 1925.

The author reviews the scientific investigations on green manuring which have been carried out in India, and studies the factors contributing to the beneficial results accruing to the soil and subsequent crops.

The two chief factors are the nitrogen and the physical factors. The former includes : — Fixation by azotobacter or similar organisms stimulated by the carbohydrates of the green manure ; denitrification induced

by fermentation of the green manure ; possible development of a bacterial toxin.

The physical factor includes : Improvement of moisture-holding power of the soil ; improved retention of plant nutrients ; possibly improved aeration ; change in soil aeration with possibly increased solubility of phosphates.

Experiments carried out on wheat in the Punjab from 1918 to 1922 showed that :—

(1) The response to green manures was much greater in sandy soils than in stiff soils.

(2) Increase in yield in sandy soils was greater in the green manured plots than in plots receiving artificial manure equivalent to the green manure.

(3) The main factor responsible for the increase in yield was the improvement in texture of the soils, due to the green manure.

(4) When the above-ground portion of a leguminous crop was removed, the yield was very much diminished.

(5) Non-leguminous crops were as effective as leguminous crop dressings. W. S. G.

Utilization of dead bodies as fertiliser on Brazilian farms.

Utilisação dos cadaveres de animaes come adubo nas fazendas. *Revista da Sociedade Rural Brasileira*, Year, V, No. 63, p. 343-344. São Paulo, 1925.

Instead of burying skinned carcases which fertilise only one spot it is advantageous to cut them into pieces and put them in a trench covering them with quick-lime and acid black soil of the fields in alternate layers. After 60 days more lime and earth are added, and so after a certain time a homogenous mixture is obtained which serves as fertiliser in variable amounts from 150 to 300 kgs. per hectare.

Another process consists in dissolving the whole carcase in a cold state in sulphuric acid at 60° Beaumé, an operation which requires 48 hours for soft parts and 8 to 10 days for hard parts.

The bones reduced to powder may be used as phosphatic fertiliser in quantities of 800 to 1200 kgs. per hectare, the effect of which lasts for 3 to 6 years. E. M.

Nitrogenous Fertilisers.

Nitrification in some organic fertilisers.

ALADJEM, E. Note sur la Nitrification de l'Azote dans quelques Engrais Organiques. *Bull. de l'Union des Agriculteurs d'Egypte*, Year 23, No. 161, p. 128-133. Cairo, 1925.

Practically all the assimilable nitrogen in dried blood, guano and pulverized horn nitrifies as rapidly as that in sulphate of ammonium ; on the other hand the nitrogen in hoof parings nitrifies less rapidly than it does

in the above, these but more rapidly than in "poudrette", cocoanut cake, and bone meal in which nitrification is rather slow.

These results indicate that these latter fertilisers should not be used except for crops which require nitrogen during a long period of growth; applied to cereals they would only have appreciable effect if given in great abundance. A. F.

The nitrogen problem.

HESPEL, M. Le problème de l'azote. *Annales de Gembloux*, Vol. 31, No. 11-12 p. 249-257 and 273-286. Brussels, 1925.

The writer investigates the nitrogen problem which is specially interesting to Belgium and recognizes that it occurs for all agricultural crops, but that rational cultivation tends to decrease the need for nitrogenous fertilisers.

Among the various processes of fixing atmospheric nitrogen, the writer recognizes that the Claude and the Haber processes and those derived from them are the most suitable; the country possessing such factories could be free from the burden of imports, by furnishing the raw materials for explosives and agriculture. The combination of the synthesis of nitrogenous products with coke furnaces would improve the conditions of the latter, also enabling coke to be supplied at more reasonable prices. The Government therefore might well interest itself in the matter, and a campaign ought to be launched against the spreading of biased reports purporting to show some superiority or other of Chile nitrate over artificial nitrogenous fertilisers. A. F.

Nitrogen Losses in Cow Urine.

DORSEY, H. *Jnl. of American Society of Agronomy*, Vol. XVII, No. 8, pp. 489-492, tables 6, Genova, N. Y., 1925.

In 1919 BEAR and ROYSTON reported that 92 % of the nitrogen in urine was lost in eight weeks if the urine was kept in flasks in a warm building, but that there was almost no loss of nitrogen in the same period when the urine was covered with a layer of kerosene.

The author's experiments were made to ascertain the nitrogen losses of urine stored in larger volume and in a cooler place, approximating to usual storage conditions.

The experiment was started on March 29 and continued until October 13, analyses being made at regular intervals.

Very little loss took place before July 1, and in no case reached 50 % by October. By the third month three-fourths of the nitrogen was converted into ammonia, and by October all nitrogen except 5 to 8 % was in the form of ammonia.

The kerosene layer reduced the loss of nitrogen fully 40 % during the whole period, and was far more effective for the first six months. The addition of a small amount of acid phosphate seemed to increase the loss of nitrogen. W. S. G.

The action of urea on soil reaction.

BRIOUX, CH. (Stat. agronomique de la Seine-inférieure). Action de l'urea comme engrais azoté sur la reaction du sol. *Ann. de la Science agronomique*, Year 42, No. 2, p. 115-124, 1 tab. Paris, 1925.

Urea at first acts on the soil as an alkali in consequence of its rapid transformation into carbonate of ammonia ; however, as it gradually nitrifies, the action of the urea becomes decidedly acidifying, approximating to that of sulphate of ammonium.

These remarks explain the facts observed by the writer : oats and white mustard manured with urea had a slower initial growth than in pots manured with nitrate and also without addition of nitrogen.

It is possible that in the sandy soil used by the writer, in which neutralization was effected with ground lime, the transformation of the urea into carbonate of ammonium may have given the soil too strong an alkaline reaction, capable of retarding the growth of the plants. This reaction decreased with nitrification whereupon the plants mentioned grew vigorously

These observations would point to the value in practice of introducing urea and fertilisers with an urea basis sufficiently early.

A. F.

The toxic effect of nitrogenous fertilisers on wheat.

MAUME, L. and DULAC, J. (Ecole nat. d'Agricul. de Montpellier). Sur la période de toxicité de divers engrais azotés à l'égard du blé au débout de sa végétation. *Ann. de la Science agronomique franç. et étrangère*, Year 42, No. 2, p. 81-107, 13 tab. Paris 1925.

The toxic effect of various mineral salts on seeds germinated in water was already known and a scale of the limits of toxicity of the various salts had also been established. The writers have investigated the question, not in aqueous cultures, but in three different types of soils (inert soil, normal arable soil and humiferous soil), observing only the effect on wheat at the start of its growth. They have also compared results of the application of the fertiliser before and 15 days after sowing.

On the whole, fertilisers may be divided into two principal groups :— those which are immediately favourable to the plant and those which on the other hand are only so after certain chemical reactions. Each of these groups corresponds with a particular case of agricultural practice and it is therefore impossible to say *a priori* whether one is better than the other but it is necessary to know the manner in which each behaves under various actual conditions.

Of all the fertilisers, the least toxic are carbonate and bicarbonate of ammonia ; their effect is best with a small dose (30 kg.) but in any case ephemeral ; after the ready nitrification so obtained, only carbon dioxide remains in the soil, of which soils normally contain enough. Also it should be remembered that the bicarbonate cannot develop its action except in a soil sufficiently provided with lime.

Urea is particularly suitable for calcareous soils which nitrify well; it is entirely soluble in water and not toxic, even in strong doses. Powdered horn has rivalled urea in fertilising power, but probably because very finely powdered.

Chloride of ammonium, in order to give a maximum yield, required the elimination of the chloride of calcium which forms its residue; to this fact should be attributed its slight inferiority to sulphate of ammonium.

Galalite should be considered as a slow acting fertiliser, rather useful for southern soils; should be spread a fortnight before sowing.

Taking the height of the stalk of wheat grown as control at 100, we get the following graduations :—

	After 3 days	After 13 days
Carbonate of ammonium	133	136
Urea	133	131
Bicarbonate of ammonium	120	131
Horn	120	131
Nitrate of sodium	77	131
Sulphate of ammonium	131	131
Chloride of ammonium	49	115
Nitrate of ammonium	35	105
Galalite	35	111

Evidently these results cannot be directly applied in practice. They show however that for the reciprocal adaptation of the plant, the soil and the fertiliser, without doubt an important factor to be considered is the period of toxicity of some fertilisers for the young plant during its initial growth. Such a factor is defined by the nature and concentration of the fertiliser, by the nature of the soil, by the interval between the sowing and manuring and, probably, also by the plant species. A. F.

Nitrate Studies on a Manured and Unmanured Soil under Continuous Wheat.

MURPHY, H. F., *Jnl. of Amer. Soc. of Agronomy*. Vol. XVII, No. 11, pp. 734-741. Geneva, N. Y., 1925.

The author describes experiments carried out on an acre of virgin land, ploughed and planted with wheat in 1893, since when it has grown wheat continuously. In 1898 one-half of the land received an application of farmyard manure, which has been repeated, the amount averaging 4 tons per acre over 26 years. The other one-half acre has not received any manure.

The investigations show that :—

Nitrates were produced in much larger quantities in the manured soil. Under greenhouse conditions the manured soil produced 1.68 times more nitrates than the unmanured soil for a period of two months. Under open field conditions 2.24 times as much nitrates were produced.

Spring growth started later on the unmanured plot.

The manured soil was superior under all conditions studied, namely, nitrates present, nitrification and moisture retention. W. S. G.

The Rate of Absorption of Nitrate of Soda by Oats and Cotton when applied at Different Stages of Growth.

APPLETON, W. H. and HELMS, H. B. *Jnl. of Amer. Soc. of Agronomy*, Vol. XVII, No. 10, pp. 596-605. Geneva, N. Y., 1925.

Experiments were made to study the rate of absorption of nitrate nitrogen by oats and cotton, when applied as nitrate of soda, at different stages of plant growth.

The results may be summarized as follows:

(1) When sodium nitrate at the rate of 400 lb. per acre was applied to oats 14 days after planting, absorption of the nitrate was very slow for three weeks. After the third week absorption increased and all nitrate was absorbed by the end of the seventh week.

(2) When the nitrate of soda was applied to oats at later stages of growth, the rate of absorption was more rapid. Nitrate applied 42, 70 and 92 days after planting was completly absorbed in 20, 14 and 10 days respectively.

(3) With both oats and cotton there was a close correlation between the rate of growth and the rate of nitrate absorption.

(4) Sodium nitrate at the rate of 600 lb. per acre was applied to cotton 14, 40 and 61 days after planting. Absorption of the nitrate was complete in 36, 14 and 11 days respectively.

(5) The results of both experiments indicate that the loss of soluble nitrogenous fertiliser by leaching may be reduced by delaying the application until the crop will absorb it rapidly. W. S. G.

Chemical and Biological researches on Cyanamide.

JACOB K. D., ALLISON F. E. and BRAHAM J. M. (Fixed Nitrogen Research Laborat. U. S. Depart. of Agriculture). Chemical and Biological Studies with Cyanamide and some of its Transformation Products. *Journ. of Agricultural Research*, Vol. XXVIII. No. I. p. 37-69. 12 fig., 15 tabl., bibl. Washington D. C., 1924.

Cyanamide becomes rapidly converted into its decomposition products (chiefly urea and ammonia), so much so that it no longer exists 5-10 days after application. Urea also rapidly undergoes disintegration into ammonia and is not accumulated. Other decomposition products (probably dicyanodiamide and guanylurea), capable of precipitation with nitrate of silver, exist for a certain time after the application of the cyanamide.

Nitrification of cyanamide takes place more slowly than that of urea or sulphate of ammonia, especially when the application is abundant. After the first slow period of 2-3 weeks, nitrification proceeds at a normal pace. Only it must be remembered that some of the decomposition products of cyanamide are toxic for nitrifying bacteria and may indirectly cause an accumulation of ammonia.

Cyanamide hydrated or oiled nitrifies as well as untreated cyanamide; the slight difference found for oiled cyanamide is due to the presence of dicyanodiamide in the hydrated cyanamide.

On the other hand the addition of carbonate of calcium retards nitrification. The latter is greatest when the moisture content is about 10 % i. e. ¼ of the saturation amount, while it almost ceases at 40 %. Sterilization of the soil with phenol arrests all nitrification.

Dicyanodiamide added to the soil disappears slowly and only one half of it is decomposed within two months ; the nitrogen which is accumulated in the form of ammonia becomes nitrified rather slowly. In any case the application of dicyanodiamide causes considerable delay in the formation of nitrates from organic substances and also hinders that from sulphate of ammonium, while it has no effect on the ammonification of urea.

Sulphate of guanylurea is decomposed rather slowly in ammonia, which is not accumulated but becomes nitrified ; in the presence of urea, it does not affect ammonification.

Salts of guanidine depress nitrification for some weeks., after which the formation of nitrates is rapid and abundant. Nitrate of biguanidine acts as an inert substance. A. F.

Is the growth of bacteria of leguminous plants possible on other plants ?

KORDES, H. (Inst. f. Agrikulturchemie u. Bakt. der Landwirtschaft, Hochschule, Berlin). Kritische Besprechung der Frage " Impfung der Nichtleguminosen ". *Zeit. f. Pflanzenernährung und Dungung*, vol. IV, No. 9, p. 382-394. Leipzig, 1925.

The question is whether only the leguminosae can absorb free atmospheric nitrogen. Such a supposition is not borne out by facts; the alder tree has morphologically and physiologically quite similar nodules, and by them can fix nitrogen, though the micro-organisms which form them are not however bacteria but actinomycetes. Other plants such as *Melampyrum pratense*, *Rhinanthus major*, certain Labiates, *Elaeagnus* and one of the Taxaceae, *Podocarpus*, possess similar nodules also having the property of atmospheric nitrogen fixation.

But this property, though not exclusively belonging to leguminous plants, is limited to a few plants only and is definitely not shared by those which are most important for human food, such as cereals.

Another problem which presents itself is that of the adaptability of *Bacterium radicicola* to other plants. It is seen that in cultures it can adapt itself well to decoctions of *Sinapis* and also to those of *Medicago*, but attempts to transplant it then on to the roots of the mustard plant were unsuccessful. The two symbiotic partners, leguminous plants and *B. radicicola*, are therefore adapted to each other ; infection of roots of other plants by this bacillus does not occur in nature and, even in experimental conditions, is quite exceptional.

It might be thought that other micro-organisms possess the property of fixing atmospheric nitrogen. In fact, HILTNER found on the roots of leguminous plants other micro-organisms similar to *B. radicicola* and was able to show in other non-leguminous plants the existence of organisms which have a determined influence on nutrition. From his theory on the rhizosphere and from some results obtained with cereals and beet he did

not, however, feel quite justified in generalizing and still less in considering that this made nitrogenous manuring unnecessary. Quite definitely results cannot be obtained with these bacilli such as we get with the nodules of leguminous plants. By their use however ENGELMANN among others has obtained with rye a crop comparing very favourably with the control plot. CARON with bacilli isolated from the roots of barley has observed the fixation of atmospheric nitrogen.

Too much should not however be expected from these observations, which remain unconfirmed despite the wide publicity given them and the products launched on the market purporting to be bacterial cultures which fix atmospheric nitrogen on the roots of cereals. The efforts of soil bacteriology should be directed towards improving conditions of life for the micro-organisms of the soil, in order that the latter, in turn, may influence the cultivated plants beneficially. This may be obtained by the introduction into the soil of sources of carbon easily assimilable and by the various cultural operations which improve its physical condition.

A. F.

Phosphatic Fertilisers

On the use of phosphorites.

D'IPPOLITO, G. (R. Staz. Agraria di Modena). *Le Stazioni Sperimentali Agrarie Italiane*, vol. 58, No. 7-9, pp. 243-248. Modena, 1926.

The writer here gives new experimental tests of manuring with phosphorites, from which it appears that in every case phosphorite has shown itself as active as superphosphate, having constantly given a slight increase of production even when not associated with sulphur; certainly in the presence of sulphur the advantage is greater.

Hitherto phosphorites have been considered of slight manuring efficiency owing to the insolubility of their tricalcic phosphate; but, according to the new view, the soluble phosphate contained in the superphosphates through physico-chemical reactions in the soil changes slowly to insoluble and then, by consecutive actions, especially of the radical juices, becomes soluble again. In phosphorites solubility is reached in the same way.

For this reason the use of phosphorites is advisable, since their phosphorus, independently of its more or less ready assimibility, represents always a considerable reserve from which successive crops benefit; they are cheaper and may mean a saving of half the ordinary expenditure.

E. G.

The solubility of natural phosphates.

CALCAGNI, O. Contributo allo studio della solubilizzazione dei fosfati naturali. *Le Stazioni sperimentali agrarie italiane*, Vol. LVIII, pamph. 1-6, p. 146-160. Modena, 1925.

From the author's experiments it appears that pure tricalcic phosphate becomes completely dissolved by bisulphate of sodium, while phosphorites

become dissolved differently according to their degree of purity ; no loss occurs during the process of solution.

The author has also investigated the action of other solvents, selecting particularly those substances which are used as fertilisers. He has thus seen that bisulphate of potassium behaves in a perfectly analagous manner to bisulphate of sodium as does also bisulphate of ammonium, the last also having the advantage of preventing retrogradation and of favouring the decomposition of tricalcic phosphate in the soil.

The above mentioned bisulphates and nitric acid therefore constitute very good solvents of phosphorites and can partly or entirely take the place of sulphuric acid.

They eliminate, or at least reduce, the drawbacks of the present method of solution and furnish fertilisers of greater value, inasmuch as they themselves, except the sodium salt, are fundamental plant elements. In this way potassium and ammonium are given in the form of phosphates rather than in the usual form, which may possible be an advantage.

A. F.

On the so-called " colloidal phosphorite ".

BOTTINI, E. (R. Staz. Agraria di Modena). *Le Stazioni Sperimentali Italiane*, Vol. 58, No. 7-9, p. 209-210. Modena, 1926.

A phosphatic fertiliser in a very fine, almost impalpable, coffee coloured powder, obtained by a process at present unknown, has recently been placed on the market under the name of " colloidal phosphorite ". It is essentially composed of phosphates of aluminium and iron mixed with organic substances.

On the whole the author's investigations only find the so called " colloidal phosphorite " colloidal to a small extent (9.79 %). Treated with distilled water, with saturated solutions of CO_2, or with solutions of organic or mineral salts it only yields these solvents usually a trace of P_2O_5.

It behaves abnormally in the presence of a 40 % solution of nitrate of ammonia, which dissolves 1.87 % of P_2O_5. Only acid solutions dissolve " colloidal phosphorite " in appreciable quantities and to a greater extent the more concentrated they are. The action of citroformic acid appears similar to that of 4.5 % solution of citric acid.

On the whole, therefore, " colloidal phosphorite " in equal doses, does not show any higher fertilising value than ordinary powdered natural phosphates.

E. G.

Colloidal silica and the efficiency of phosphates.

GILE, P. L. and SMITH, J. G. (U. S. Depart. of Agriculture). Colloidal Silica and the Efficiency of Phosphates. *Journal of Agricultural Research*, vol. XXXI. No. 3, p. 247-260, 4 pl., 1 tab., bibl. Washington D. C., 1925.

In the practice of manuring it is known in a very vague manner that there are reactions between the soil and phosphatic fertilisers which influence the efficiency of the latter.

Thus phosphorites and bone meal can give the same effects as superphosphates in one soil and, on the other hand, be ineffective in another, even with the same crop. The variations in the yield produced by a given quantity of phosphorites in different soils are too considerable to be attributable to the so-called secondary effects, such as the decrease of acidity, the provision of lime, etc. On the other hand the scanty efficiency of phosphorites in quartz sand cultures, and on the contrary the good results which are obtained in certain soils, indicate rather that we must be dealing with conditions which favour the assimilability of phosphates.

The writers have made experiments by growing millet in sand and have observed that the addition of colloidal silica considerably increases the growth of plants manured with phosphorites, while the increase is very slight for crops manured with superphosphates. The increase is approximately proportional to the quantity of P_2O_5 added, but does not seem to have any relationship to the quantity of silica. The addition of a mixed colloid, containing iron, alumina and silica in a pot manured with phosphorites tended to a decreased yield in comparison with that without phosphates. The beneficial action of the silica has been attributed to increased assimilability of phosphates through the increase of the P_2O_5 in solution

Probably the colloidal solution of silica increases the decomposition of the phosphorites, absorbing the hydroxide of calcium which is one of the final decomposition products: it is also possible that the colloid acts by absorbing the OH ions. Analogously the mixed colloid of iron, allumina and silica acts unfavourably by diminishing the quantity of P_2O_5 in solution, because of the soluble iron and aluminium produced by the exchange of bases.

Certainly the action of the silica colloid in the simple medium of the experimental conditions does not correspond with that of the colloidal matter existing in the soil. In any case the increased growth of plants cannot possibly be attributed to increased assimilation of silica. A. F.

Basic Slags and Rock Phosphates.

VANSTONE, Dr. E. *Jnl. of Soc. of Chem. Ind.*, Vol. 44, No. 14, pp. 155-157, figs. 2. London, 1925.

In a former paper (1) the ratio of phosphate soluble in 2 % citric acid to total phosphate content was investigated. It was shown that for three basic slags, differing in phosphate content, the ratio was constant and independent of the weight taken in the test.

As the method of successive extractions with citric acid was employed, it was desired to investigate the ratio of citric-soluble phosphate to total phosphate in the residual phosphate, after a first extraction with 2 % citric acid.

The same slags used for the first experiments were utilised, and it was evident that the residual phosphate is much less soluble than the phosphate removed in the first extraction. These slags are therefore mixtures of phosphates of different solubility in citric acid.

The effect of ignition on the solubility of rock phosphates was also stu-

(1) See *R.* 1925, No. 559, (*Ed.*).

died, and it was found that the solubility was very much reduced by ignition. It was also found that calcium pyrophosphate ($Ca_7P_2O_7$) has a much lower solubility than other calcium phosphates, except fluor-apatite, which is practically insoluble. W. S. G.

Effects of phosphatic manuring on the quality of hay and fodders.

ROBERTSON, G. S. Efecto de los fosfatos brutos y de la escorias de defosfaración en la calidad del heno y de los pastos. *Boletin de la Comp. Admistradora del Guano*, Vol. I, No. 7, pp. 245-250. 1 fig. Lima, 1925.

The most important direct effect of the application of basic slag is the notable improvement in the quality and food value of the fodders. From the writer's experiments it appears that various basic phosphates (mineral phosphates, highly and slightly soluble slags, basic superphosphates) produce the same improvement and in equal measure.

In soils poor in lime, superphosphate has an unsatisfactory influence especially on leguminous plants, inasmuch as it favours grasses.

Mixing it with lime, we get basic superphosphate, which is a stimulant for the leguminous plants.

Lime alone in these soils, does not exercise any action. A. F.

The solubility of phosphates and the growth of Azotobacter.

NIKLAS, H. SCHARRER, K. and STROBEL, A. (Agrikulturchen Inst. der Hochschule Weihenstephan). Phosphatlöslichkeit und Azotobacterwachstum. *Landwirtschaftliche Jahrbücher*, vol. LXIII, No. 3, pp. 387-410. Berlin, 1926.

As regards pure salts, the best growth of azotobacter is obtained with magnesium salts ; next come those of calcium, potassium and sodium ; iron salts do not permit of its development.

The mono- salts of magnesium and of sodium give a better development than the corresponding di- salts ; on the other hand with calcium salts we get equal results with either ; monopotassic phosphate gives a slightly inferior development to that which is obtained with dipotassic phosphate. As regards artificial fertilisers, P_2O_5 phosphate soluble in citrate and in citric acid gives a better development than tricalcic phosphate.

On the whole a clear relationship is observed between the solubility of the phosphates and physiological utilization by Azotobacter. Further research to clear up these interesting questions is essential. A. F.

Sources of error in the determination of phosphoric acid by the " Molybdate-Magnesia " method.

MC CANDLESS, G. M. and BURTON, J. Q. (Mc Candless Laboratory, Atlanta, Ga.), *Industrial and Engineering Chemistry*, vol. 16, No. 12, p. 1267-1270, December 1924.

The writers start by pointing out that the great differences in results obtained by chemists in the determination of phosphoric acid, in products

of high P_2O_5 content, by following the official methods, whether gravimetric or volumetric, are principally due to the various quantities of hydrochloric acid which the chemists use for the purpose of neutralizing the ammoniacal solution of the yellow precipitate, in accordance with the instructions given in text books, without having the help of a suitable indicator to show the exact point of neutralization. The temperature at which pyrophosphate is calcined has also a great influence in the gravimetric determination.

From the results of practical experiments reported by the writers it appears that a solution may be accurately neutralized by the use of litmus paper and precise results obtained. If hydrochloric acid is added in such quantity as to exceed this point of neutralization, too high results are obtained. If, on the other hand, the solution is alkaline owing to the presence of free ammonia, we get too low results.

The writers in their note describe minutely in every detail the method successfully used by them to obviate the drawbacks indicated and obtain very precise results. L. M.

Potassic fertilisers.

The study of the equilibrium set up between water and potassium salts.

CORNEC, E. and HERING, H. Equilibrios entre el agua, el nitrato de potasio y el sulfato de potasio. *Caliche*, year VII, No. 7. Santiago, 1925.

Knowledge of the state of equilibrium between water and sodium salts (nitrate, chloride, sulphate) is fundamental for the scientific study of the Chile Nitrate industry; the Nitrate contains, in addition to sodium, other elements :— calcium, magnesium, potassium, which should be taken into consideration, unless found in negligible quantities, because they are accumulated in the soil water and thus enter into the cycle of nitrate formation. It is thought that the difficulties which are sometimes met with in extracting the potassium contained in Chile nitrate depend, at least partly, on the existence of a sulpho-nitrate of potassium which would correspond with certain conditions of solubility.

From the writers' experiments, on the other hand, it appears that within fairly large limits of temperature (from 3.3 to 100°) sulphate and nitrate of potassium cannot combine to form a double salt in the presence of water. Potassium so differs from sodium, ammonium and lithium which can form sulphonitrates.

Practically, the separation of nitrate of potassium from sulphate of potassium is effected in the same way as that of nitrate of sodium from chloride of sodium.

The study of cases in which sodium and potassium are present at the same time is thus simplified by the fact that a double salt between nitrate and sulphate of potassium does not exist.

A. F.

Potassic manuring of the vine.

DUSSERRE, C. and GODET, CH. Fumure potassique de la vigne, son influence sur le rendement et la qualité du raisin. *Annuaire agricole de la Suisse,* p. 639-643. 1925.

The addition of potassic salts to the ordinary manuring of the vine has had the effect of increasing the number of bunches of grapes which reached complete development and of slightly increasing their weight compared with the others.

The weight of sugar elaborated per acre was greater for the vines which had received the potassic manuring, but being spread over a considerably larger number of grapes the actual sugar percentage of the grapes decreased, which meant a lower alcohol content in the wine.

The total acidity and the proportion of tartaric acid were slightly higher in vines which had not received the potassic manuring.

As regards the comparative action of the chloride or sulphate salt the mean yield was greater with the former ; there is no appreciable difference as regards the components of the must and wine.

The taste, however, enabled the wines obtained by potassic manuring to be classed as better, without being able to differentiate between the two salts. A. F.

Iodine fertilisers for sugar beet.

UNGERER E. (Agrikulturchemisches Institut der Univ. Breslau). Ueber die wirkung einer Jodkali-Beigabe zu Zuckerrüben. *Zeit. f. Pflanzenernährung und Düngung,* vol. IV, nº 9, pp. 369-374. Leipzig, 1925.

STOKLASA had recently related the good results obtained by him by means of the addition of small quantities of iodine in the form of iodide of potassium in the growth of sugar beet, especially as regards the yield in roots.

In the experiments of UNGERE, on the other hand, which admittedly were not continued up to the full maturity of the plant, the addition of iodide of potassium during the 3 $^1/_2$ months of growth did not have the effects stated by STOKLASA and there was actually rather a decrease in the yield of roots and in the sugar content. A. F.

Substances aiding development.

Notes on " Promoloid Asahi ".

BOTTINI. E. (R. Stazione di Chimica agraria di Torino). Sul " Promoloid Asahi ". *Annali di Chimica applicata,* vol. 16, No. 1, p. 29-39. Rome, 1926.

" Promoloid Asahi " is a colloidal silicate of magnesium which is said to have the property of favourably influencing the growth of plants, improving their quality and increasing the yield.

Nowadays the absolute necessity of magnesium for all plants is recognized.

The principal functions attributed to it are those which it exercises :—

(1) on the circulation of phosphoric acid ;

(2) on the chlorophyll function ;

(3) on the formation and migration of starch and other carbohydrates ;

(4) on the formation of the protein substance of protoplasm ;

(5) on the development of nitrifying bacteria.

The writer's experiments show that " Promoloid " exercises a beneficial action in all soils, especially on their permeability and capillarity, while, except in occasional cases, it has little influence on the powers of drying and absorption.

In sandy soils it moderately decreases the permeability and slightly decreases capillarity, thus partly eliminating the drawbacks of the constitution of these soils. The power of drying remains almost unchanged and so also the power of absorption of salts, with the exception of chloride of ammonia, its absorption power for which is slightly increased. In clay soils permeability is much decreased, while capillarity increases, thus facilitating the movement of soil solutions from below to the surface. The powers of drying and absorption here again remain almost unchanged.

In calcareous soils the permeability decreases moderately, while the capillarity and power of drying remain unchanged. The power of absorption of chloride of ammonia becomes slightly greater.

In humic soils the permeability decreases largely and the power of drying and the capillarity increase considerably. The power of absorption of chloride of ammonia becomes greater and on the other hand that of nitrate of sodium decreases. The principal effect in these soils is a decrease of acidity. A. F.

Research on the influence of boron on plants.

CUSUMANO, A. *Le Stazioni sperimentali agrarie italiane*, vol. 58, No. 10-12, pp. 440-448. Modena, 1925.

Boron is found moderately diffused in plants and it even seems that in some it forms a regular part of the composition of certain organic substances. According to some it is found in soils containing tourmaline, according to others on the other hand it is brought into soils with artificial fertilisers and especially with Chile nitrate, guano and kainite.

The opinions of investigators on the action which boron exercises on plants are various, inasmuch as some consider that it has a stimulating effect, while according to others its effect is injurious.

The writer has made experiments with a mould (*Aspergillus niger*) and with pot cultures of lupins and beans.

Boron not only does not hinder the regular development of *Aspergillus*, but even helps it when given in doses of less than 0.010 %, the optimum dose being 0.005 %.

It has a similar effect on lupins and beans ; in these cases, the plants with the addition of boric acid or boraciferous earth also look better. The optimum dose of boron is that of 0.50 gr. per square metre of surface.

Identical results were obtained with experiments in the open field on tomatoes, wheat, potatoes and maize.

It should therefore be considered that boron acts as a stimulant for the absorption of soil elements useful to plants. A. F.

Tests with " Soilgro ".

LEONARD, L. T. *Jnl. of Amer. Soc. of Agronomy*, Vol. XVII, No. 10, pp. 623-629. Geneva, N. Y., 1925.

Attempts are still made to produce a culture of soil bacteria which, when added to the soil, will greatly stimulate plant growth. The latest of these is " Soilgro ", and the following data were obtained as a result of experiments made by the Bureau of Plant Industry, Washington. The material is sold in two metal containers, one holding the bacteria and the other " bacterial food ".

The total number of bacteria in the Soilgro cultures tested was much lower than in the so-called bacterial food. Soil and manure samples gave higher figures.

The numbers of ammonifying and cellulose destroying bacteria were also larger in bacterial food, soil and manure samples than in Soilgro cultures. The presence of Azotobacter was not indicated. Legume bacteria were found, but in less number than in potting soil.

Nitrogen fixing by potting soil was superior to the fixation by a Soilgro culture.

The nitrification of ammonium salts in liquid and in soil cultures was better achieved by potting soil than by any of the Soilgro preparations.

Soilgro showed no superiority in the production of radishes, either in the stimulation of germination, earliness of crop, or weight of crop collectively or individually. Tests made with peas were also negative. Two tests on lawns did not produce results favourable to Soilgro. W. S. G.

Communications.

An International inquiry regarding the Control of Fertilisers. — The International Institute of Agriculture has just been making an International inquiry regarding the control of fertilisers and fungicidal and insecticidal products.

This inquiry, in pursuit of which a questionnaire was sent to countries who are members of the Institute and to numerous other correspondents, will serve as a basis of the report of Professor Jelinek for the control of fertilisers in the various countries. It is a consequence of a decision of the International Commission for the Study of Chemical fertilisers, a decision ratified by the VIII General Assembly of the Institute.

The questionnaire contains some fifteen questions on the existence and application of control methods (methods of analysis, etc.) regarding fertilisers,

fungicides, insecticides, and other chemical products utilized in agriculture. The International Institute should thus be able to collate information valuable for improving the methods and control services of all countries.

One extremely useful practical result for agriculture should be the possibility of making uniform and internationalising the chemical and other control methods used, a step calculated to facilitate business and to safeguard agriculture.

Conference for propaganda in favour of nitrogenous fertilisers. (Biarritz - France -, 27 and 28 April 1926). — On the joint invitation of the British Sulphate of Ammonia Federation of London and of the Stickstoff-Syndikat of Berlin a certain number of persons distinguished in agronomic science and the nitrogenous fertiliser industry met at Biarritz, at the Hotel Regina on the 27th and 28th April 1926 to study questions relating to propaganda for the use of nitrogenous fertilisers.

The meetings were presided over by Mr. D. Milne WATSON, President of the British Sulphate of Ammonia Federation. Among the papers given, all by eminent specialists of the fertiliser industry, that of Dr. J. BUEB of the Stickstoff Syndikat of Berlin on the *Determination of price and creation of new forms of nitrogen fertilisers as factors in propaganda* is worth noting. He shewed that in Germany particularly the development of nitrogenous fertilisers was due to the fact that up to 1923 the price of these fertilisers was fixed by the State. With the fall in the value of the currency, nitrogen could thus be placed at the disposal of agriculturists at an extremely low price. The consumption of nitrogenous fertilisers has consequently become considerable in Germany. Thus German agriculture consumed in 1924-1925 335 000 tons of pure nitrogen, against 240 000 in 1923-1924, a fact that demonstrates the result of the fixing of a very low sale price on developing the use of fertilisers.

Dr. BUER went on to mention the creation in Germany of numerous new fertilisers, notably the BASF Potash-nitrate of ammonia, the BASF Leuna nitrate (sulpho-nitrate of ammonia) among nitrogenous fertilisers, to mention only the latest.

The " Diammonphos BASF " is a pure diammoniacal phosphate, $(NH_4)_2\,HPO_4$ containing 19 % of nitrogen and 47 % of phosphoric acid. The " Leunaphos BASF ", a mixture of sulphate of ammonia and Diammonphos, which contains 20 % of nitrogen and 15 % of phosphoric acid is very suitable to the German cultural practice which demands a fertiliser containing nitrogen and phosphoric acid in the proportion of 1 to 0.75.

Lastly a new fertiliser " Leunaphoska BASF " has been made for export to countries where it is not possible to recommend the use of separate fertilisers, owing to present lack of information on the various requirements of their soils.

Leunaphoska, suiting all soils, meets this aim. It contains 13 % of nitrogen, 10 % of phosphoric acid and 13 % of potash. The presence of phosphoric acid and potash assures the action of the nitrogen.

Mr. F. C. O. SPEYER, General Manager of the British sulphate of ammonia Federation next spoke, strongly supporting Dr. BUER's views on developing the use of fertilisers by lowering the price and then favouring such use in various situations by creating efficient types of fertiliser.

He also showed that the producers were combining for the sale of all nitrogenous fertilisers without distinction of methods of manufacture.

Mr. SPEYER spoke of the fact that agriculturists decrease their purchases of fertilisers for a long time after they have suffered from a fall in agricultural produce, and suggested therefore that the manufacturers should resist the temptation to raise prices on account of temporary agricultural prosperity.

Professor Dr. HERMANN WARMBOLD of Berlin in his communication :— *The conditions and objects of the use of nitrogen in relation to propaganda*, recalls the difficulty which is found in fixing a general relation between the quantity of fertiliser used and the increased yield obtained. This relation is constantly variable. Nevertheless it may be remarked that, other things being equal, it is noticed that the increases in yield diminish according as the latitude increases.

Moreover when the doses of fertiliser are increased, the return per unit of fertilising element used diminishes. Lastly little is known regarding the relations between the use of fertilisers and the yields in tropical regions.

We cannot follow up this speaker's numerous ideas or recollections of data concerning the advantages of the use of fertilisers, economizing ground and manual labour.

M. J. GALLAND of Paris and Mr. T. H. J. CARROLL of London took part in the discussions. Prof. Dr. ERWIN BAUR, Director of the Institute " für Vererbungslehre Landwirtschaftliche Hochschule " of Berlin spoke of the *Creation of new types of plant species capable of responding to maximum dressings of fertilisers*. He recommended the selection of varieties which would absorb fertilising material in large amounts, a selection to be made in plots specially charged with fertilisers.

Prof. Dr. H. NILSSON-EHLE, Director of the Sud Research Station at Svälof Sweden, and Professor of Genetics at the Lund University at the same place, gave a lecture on *Nitrogen Fertilisation and Cereal Breeding*, showing the necessity that the science of cereal breeding should remain firmly faithful to the aim of the highest productivity in combination if possible with the maximum stiffness of stem. He passed in review the principal problems of cereal breeding, drawing attention to the most important desiderata, such as, among others, precocity and resistance to diseases, two characteristics essential in intensive cultivation.

Dr. Russel OAKLEY of Washington and Dr. J. A. LIPMAN of New Jersey took part in the discussion. Prof. Dr. Karl BOSCH of Ludwigshaven spoke of the importance of propaganda for the use of fertilisers.

PROCEEDINGS OF THE INTERNATIONAL ASSOCIATION OF POULTRY INSTRUCTORS AND INVESTIGATORS

Papers.

Investigations concerning the Operation of Foods containing Herring-pickle and bits of Herring for fowls, a Contribution to the Question of Kitchen-salt poisoning in Poultry.

AV. ERICH, Dissertation from the Tierseucheninstitut der Universität Leipzig, Direktor Prof. Dr. A. BER. 26 pp. Leipzig, 1925.

Feeding tests with fresh, unwatered herring have shown that in general only small quantities were eaten by the fowls tested. Afterwards, with the exception of thirst and a slight degree of diarrhoea, no appearances of illness were observed.

From the experiment with herring and herring salad watered for 24 hours it appears that in this form also only relatively small quantities of herring were eaten, which in no case contained a dose of kitchen-salt fatal to the fowl.

It is to be assumed that with the cases of herring-pickle poisoning observed in practice, in many cases it was a question of pickle which was already decomposed. On the decomposition of herring-pickle there arises, side by side with other decaying products, the specific smell of trimethylamin dependent on herring-pickle.

4.0 gm. of kitchen-salt are capable of killing a fowl weighing 1000 gm., but only if, during the first 24 hours, no water can be taken in. If a sufficient quantity of water is available, then 4.5 g. of kitchen-salt per kg. of body weight are digested in some cases without injury, whereas with fowls possessing a smaller power of resistance this quantity will cause an illness ending in death. Fresh herring-pickle, herrings and parts of herrings not in process of decomposition, only operate fatally through their content of kitchen-salt.

Avian Variola and Vaccine. Immunity in Avian Variola.

J. BASSET. *Comptes rendus des Séances de la Soc. de Biologie*. Paris, Vol. XCIV, No. 3, p. 525. 1926.

Vaccine excepted, animal variola is considered as rather narrowly specific and only suceptible of being transmitted to the species which shows the spontaneous discease. BASSET has not succeeded in infecting mammals e. g. cow and rabbit with chicken variola.

The experiments of the writer with vaccine virus permit of the conclusion that vaccine virus and avian virus are different, since animals immunized against one virus retain all their natural receptivity for the other.

To obtain local immunity *i. e.* immunity of the receptive tissues it is by no means necessary to introduce the virus into these tissues.

A Case of poultry spirochaetosis in Germany.

Dr. R. BERGER. *Deutsche tierärztliche Wochenschrift*, No. 10, p. 169, 1926.

In the Institute in 1924 spirochaetosis was observed for the first time in poultry here in two 6 months old pullets. An exact description of these cases follows, also a summary of literature.

In blood preparations coloured according to MAY — GRÜNWALD — GIEMSA, numerous spirochaetes were found. Blood samples prepared in accordance with the BURRI Indian ink process also showed the presence of numerous spirochaetes.

These can also be easily seen in samples taken from the liver, spleen and kidneys. After the passage thorough the blood stream of the spirochaetes the appearance of illness in the hens subsided more and more, and the number of spirochaetes in the blood decreased constantly.

It was not possible to discover a definite source of infection which would explain the outbreak of spirochaetosis in the pullets.

Pigmented Testicles in Poultry.

Dr. HEINRICH BITTNER. *Berliner Tierärztliche Wochenschrift*, No. 34, page 533. Berlin. 1925.

Dissection has revealed the presence of dark coloured testicles in poultry. This striking and peculiar appearance is mentioned neither in the modern text-books on the anatomy of poultry, nor in the descriptions of poultry diseases.

It is to be traced to actual pigmentation by melanotic pigment. BITTNER describes thoroughly histological investigations, and gives illustrations of paraffin sections. The histological findings allow it to be understood that the dark colouring of the testicles is caused by melanophores mainly branching, rarely spherical, which lie in the intertubular tissue and in the tunica albuginea. The core of these melanophores is similar to that of the Leyden intermediate cells.

No explanation can be given of the pigmentation described. The pigmentation of one or both testicles, often observed with singing birds, also occurs with poultry.

In conclusion BITTNER gives an exhaustive bibliography of 83 numbers.

The Poultry Industry in 1925.

EDWARD BROWN. Essex Street 20-21. London, January 1926.

There has been a considerable increase in the number of poultry kept in the United Kingdom within the last few years. One of the most satisfactory

features during 1925 was the growing interest taken by farmers in egg and poultry production. The poultry production value was in 1925 greater by 47.85 % than the wheat crop, 112.88 % above the barley crop, and 76.63 % more than the oat crop in the same year.

During the year under review the National Poultry Institute Scheme has made marked progress and the central Institute at Harper Adams, Newport, Salop, will soon be completed. Important work is in progress dealing with diseases of poultry.

The production of table poultry has recovered to a large extent. During the year exhibitions have made considerable advance both in numbers and influence. It is most satisfactory to record the greater recognition of production value in the stock.

The author gives many figures about imports into England of eggs, live and dead poultry.

Action of the sexual Hormone on the Comb of Gallinaceae.

Ch. CHAMPANY. *Comptes rendus des séances de la Société de Biologie.* Paris, Vol. XCIV, No. 5, p. 311.

1) Graft of the genital gland in the comb of the capon. CHAMPY introduced a thin slice of testicle into the combs of 3 capons. The birds showed a regrowth of the comb. The comb became equal to that of a normal cock.

2) In capons subjected to testicular transplanting the muco-elastic tissue quickly starts again to swell 2 or 3 weeks after grafting under the skin of the back. This tissue therefore shows well sensibility to the sexual hormone.

A simple phenomenon of imbibition and rejection of sensitive tissue seems therefore to be the origin of other modifications which are observed in the comb.

The Feathered World Year Book 1926.

R. and O. COMYNS-LEWER. *The Feathered World.* 9 Arundel Street, London.

The Feathered World has this year surpassed every thing published in this business for years. In a very sound book of 560 pages are published different interesting poultry problems and a number of good photos. Some introductory notes by S. H. LEWER and the first article, on the Poultry Industry in 1925, by Edward BROWN show us the standpoint of the British Poultry Industry during 1925.

Among the articles are : The Diseases of Poultry, The " addled " Egg, Yearly activities among the Bees, Economically successful Breeds of Rabbits for Fur production, How to make money by rearing Angora Rabbits for Wool production, A Year on the Poultry Keeper's Garden, Things seen and noted by the Utilitarian. Follows a description of about 120 different

breeds of Hens, Ducks, Geese and Pigeons by specialists. A very useful Handbook indeed for the poultry keeper.

Fresh and Preserved Eggs.

FILANDEAUR and VITOUX. *Annales de Falsifications*, November 1925. Ref. *Recueill de Médécine Vétérinaire*, Paris, Vol. CII, No. 1. p. 40. 1926.

The fresh egg cooked hard, easily taken out of the shell, presents an air chamber of very small dimensions, the white is opalescent, very homogeneous and elastic, the yolk generally well centred is rarely apparent and never in contact with the shell, the smell is fresh.

When eggs preserved by processes based on stopping the pores of the shell (eggs in waterglass) are cooked, 9 times out of 10 the egg cracks when it reaches about 70°, and it does not crack at random like an egg whose shell is defective, but always breaks along a line following the direction of its larger axis. This characteristic appears to be specific.

The shell of the hard egg is difficult to remove, the air chamber generally reduced, the yolk is apparent being displaced towards the points and often in contact with the shell, the white is not firm but slightly elastic often dividing into two or three layers.

With eggs from cold storage it is often noticed that when placed in water they stand upright on one end (sometimes some are found to float). When cooked they show an air chamber generally of considerable size (sometimes 1/8 or even ¼ of their volume) and of irregular shape. The yolk, displaced, is apparent and in contact with the air chamber, the white of unpleasing appearance, sometimes greenish or pink, is flabby, sometimes granular ; on breaking it becomes divided into several layers more or less concentric, the smell is disagreeable.

Eggs preserved by the Lescard process are more tricky to recognize. Eggs in which the air chamber is very reduced in size are, when cooked, difficult to get out of their shells. If the shell is removed with some care a curious and characteristic phenomenon is sometimes observed. In consequence of the effect of the vacuum to which the egg has been subjected, the hyaline membrane is detached from the shell and in the small cavity thus formed is found a drop of water which has either entered during the boiling or has resulted from a phenomenon of dialysis.

The white is fairly firm and more normal in appearance, but it still divides into concentric layers. The yolk is apparent and displaced towards the narrow end.

The authors have also noted the character of the broken egg. Displayed on a plate, the fresh egg shows a dense homogeneous white with a very slight more liquid border. With preserved eggs two layers are distinctly noticed in the white, one of dense consistency surrounding the yolk and the other much more liquid envelopping the former and spreading on its edges. Its importance increases with the age of the egg. If on the other hand the white is collected in a test tube, it is noticed that that of the fresh egg, without being limpid, is homogeneous, while that of the preserved egg often shows granules of an albuminous substance.

Chickens to the Fore.

Dr. B. M. GONZALES. *Philippine Free Press.* Manila, November 7, 1925.

In the Philippines there is a considerable agitation about keeping out the Chinese. But that is only one phase of the problem. Why should the Philippine people pay over one million pesos to China each year for such a simple matter as eggs, when that amount might as well be kept at home? The College of agriculture at Los Baños now gives a full description of the improved Cantonese chickens of Los Baños, which lay an average of 115 eggs a year.

The Cell forms of the loose binding-tissue of Birds.

R. HERRMANN. *Deutsche Tierärztliche Wochenschrift.* Hanover, p. 111, 1926.

Views on the occurrence and signification of the cell forms of the loose binding-tissue are not yet clear. Literature gives little information on the binding-tissue of birds. In his investigations HERMANN has made use of the subcutaneous binding tissue of sparrows. He has found: (1) Fibroblasts, (2) Mast cells, (3) Clasmatozytes, according to MAXIMOW called " quiescent travelling cells ", (4) Small amoeboid travelling cells, (5) Plasma cells. In the binding-tissue of sparrows he was not ableto find the eosinophillic cells described in the binding-tissue of mammals.

On the Significance of Small Stones in the Gizzard of Fowls.

JAECKEL, Y. Dissertation from the Institute of Animal Physiology of the Agricultural High School at Berlin, Director Prof. Dr. MANOLD. *Cremers Beiträge zur Physiologie.* Vol. III, No. 1-3. Verlagsbuchhandlung von Richard Schoetz, Berlin SW 48, 1924.

There is given a method of operation which enables gizzard stones to be entirely removed from the muscular gizzard of the fowls.

The frequency of the movements of the gizzard of the fowl is not influenced by the removal of the small stones contained in the gizzard.

The gizzard pressure, that is, the power of the gizzard contraction, also remains the same when the gizzard is without stones.

By careful feeding, fowls without stones can be kept alive for months, but in the foregoing tests success in maintaining such animals, grain fed. in a condition of even, nourishing weight, was not attained.

The little stones found in the gizzard of the fowl have no share in the formation of egg shell.

Contribution to the Macroscopic and Microscopic Anatomy of the Intestine of *Gallus domesticus*, with Special Consideration of the Intestinal Villi.

A. KRÜGER. *Deutsche Tierärztliche Wochenschrift*, p. 112. Hanover, 1926.

These investigations dealt particularly with the intestinal villi of poultry, comparing them with those of man, dog, cattle, sheep, pigs and geese.

The length of the intestinal tract of gallus domesticus has left nature plenty of room for action. The type of food etc. influences the length of the intestinal canal. The length of the intestine, with fully grown fowls, varies approximately between 260 and 170 cm. The width of the intestinal canal varies likewise.

The mucous membrane is furnished with villi up to part of the caecum from the gizzard to the cloaca.

Noduli lymphatici aggregati appear in the duodenum, not in the colon, but on the other hand are found in the jejunum and ileum at intervals of about 50 cm.

Noduli lymphatici solitarii are missing in the duodenum and the colon, but otherwise are to be met with in the whole course of the small intestine.

A further peculiarity is the appearance of structural folds on the mucous membrane of the blind intestine and the colon.

In the hen, without the width of the intestine being much altered, the ileum continues straight through the colon, quite independent of the caecum. The blind intestines are blind sacks of the colon, and are in no relationship to the embryo. At the entrance to the colon and penetrating into it is formed a ring-fold, valvular coil.

A thorough study is made of the diverticulum caecum vitelli. The embryological development of the intestine of the hen is exhaustively worked out. The differences in the microscopic formation of the villi, and folds are brought into great prominence. The form and size of the villi vary considerably in the different sections of the intestine. They form rows of funnels or sluices, which run at an angle of about 20 degrees to the direction of the intestine, and wind themselves in a spiral down the intestines.

Has the Pepsin of Poultry the Capacity of Penetrating Vegetable Cells, and what is digested from these ?

KRÜGER. *Landwirtschaftliche Jahrbücher.* Vol. LXI. No. 6. p. 909.

The ferments pepsin and trypsin have the capacity of penetrating vegetable cells and digesting albumen from them : fat remains in spite of the loosening of the structure of the cell wall in the cells.

In the gizzard of the hen the glutinous cells are not altered by the hydrochloric acid of pepsin; only plasmolysis and change of colour are shown with fresh vegetable cells. The peculiar proteolysis takes place first in the intestine, after the food has been previously mechanically reduced in the gizzard. Fresh cells of elodea, grass, lettuce and cabbage appear digested uninterruptedly in the excrement. Glutinous cells of oats and wheat are often thoroughly digested, or considerably decomposed ; by previous kibbling of the grains, the digestion can be carried still further, indeed starch appears in the residue ; cooking the grains reduces the digestion of the glutinous cells.

What this amounts to in practice is that poultry is capable of preparing vegetable cells in a mechanical way for the penetration of the gastric jui-

ces ; pulverizing or cooking of the grains can be done without damage. The albumen contained in the grain fodder is to a great extent digested from the cells and resorbed, the fat, so-called, of the cells remains in the cells and escapes resorption.

Coccidiosis of the Rabbit or Big Belly Disease.

Dr. EM. LEYMEN. Federation Nationale des Sociétés d'Aviculture Ministry of Agriculture. Brussels, 1926.

An interesting paper on coccidiosis of the rabbit. Description of coccidia, of symptoms of the disease, prophylaxis and a type of hutch in which the excreta are automatically removed after their ejection, so doing away with the necessity for litter to which the excreta always remains adherent.

Avian Plague.

EM. LEYNEN and R. WILLEMS. *Annales de médicine vétérinaire*. Brussels, Dec. 1925.

A very interesting paper on avian plague dealing with the history of this disease and giving very fine illustrations.

In Belgium Dr. LEYMAN noticed the disease on the 30th May 1925. It had broken out following a purchase of foreign pullets.

The disease made considerable ravages. The infected bodies had been thrown into the la Nèthe river and had contaminated the drinking water. With the object of controlling the importation into Belgium of foreign poultry affected with contagious diseases, a Royal Decree of the 18th October ordered the controlling veterinary officer to send the bodies found in the crates to the laboratory in order to diagnose the cause of death. Meanwhile the poultry remained in quarantine.

As a result of the new regulation on three occasions a diagnosis of "Avian plague" and twice a diagnosis of "Cholera" has been given out of six despatches of dead poultry found in the crates at the import offices, and on that account this poultry has not been allowed to enter the country.

The Poultry Industry of Wales. A Survey of Stocks, Methods and Prices.

J. MORGAN JONES. Agricultural Economics Department. Aberystwith 1925.

This booklet of 50 pages gives information, which explains many of the reasons why the poultry industry has not made greater progress in Wales, where the small farm conditions are generally found to be most favourable to its development.

The relative production, save in the case of geese, is much lower than in England. Experience has proved that the bulk of producers if left to themselves will take few, if any, measures to ensure the marketing of fresh eggs.

Vitamin A Content of Fresh Eggs.

MURPHY J. C. and BREESE JONES D. (Bureau of Chemistry U. S. Dep. of Agriculture). Vitamin A Content of Fresh Eggs. *Jnl. of Agricultural Research*, Vol. XXIX, No. 5, pp. 253-257, 4 fig. bibl. Washington D. C., 1925.

Feeding experiments have shown that in 0.50-0.75 g. of new laid egg a sufficient quantity of vitamin A is given to allow of the normal growth of young rats. A smaller quantity (0.25 g.) was shown to be sufficient to cure advanced cases of Xerophthalmia. A. F.

Contribution to the Question of the Injuriousness of Steeped Corn as Poultry Food.

NIEBER, CARL. Dissertation of the Tierärztlichen Hochschule Berlin, p. 9. 1925.

First feeding experiment with steeped grain.

4 series of tests, each with 10 hens, the duration of test being 14 days. As the medium for soaking there were used Germisan, AZ 3, Segetan-neu, agfa pickle, Upsulun, Urania seed pickle, Blue stone, Calimate, Corbin, Fusel oil, Tillantin B and Tillantin C.

The quantity of corn administered amounted to 150 g. per head per day. With one half of the animals experimented on, this quantity was given from the first day onwards; with the second half 50 g. were given on the first day, 100 on the second, and not until the third day were 150 g. given and continued. The hens took all the scattered grain willingly, obviously suffering no disturbance to health. Only the grain steeped with fusel oil they took unwillingly the first day of feeding; afterwards they got accustomed to it.

Eggs from hens which had fed on grain treated with corbin had a sharp tar-like taste when boiled.

When feeding with grain steeped in Blue Stone special caution is recommended.

Second experiment with pickling material in Solution:

Each 2 hens had 2 % and 5 % solutions of germisan, upsulun and calimate administered by the throat-probe. The animals died after taking about 0.2 g. quicksilver, or about 0.5 g. chlorophenol-quicksilver, or about 0.1 g. phenol and 0.08 g. formaldehyde.

The experiments admit of no conclusion as to the danger of feeding other agricultural domestic animals in such a way. The question as to the operation of steeped grain on other kinds of fowls, as also on other agricultural domestic animals, requires still further explanation.

Some new Facts regarding the Grafting of ovaries in the Domestic Cock.

PÉZART, SAND and CARIDROIT. *Comptes rendus des Séances de la Société de Biologie*, Vol. XCIV, No. 8, p. 520, 1926.

From 3 cases it results that the survival of ovarian grafts made in the cock may last several years during which the bird remains fertile and endocrinian.

Moreover the evolution of the follicles does not present any real anomalies when the ovarian tissue is transferred from the hen to the cock.

Lastly in one case the duration of the transplant was obtained in spite of the presence of the testicular mass of the bird operated on, that is to say, under conditions which we usually consider as very unfavourable.

Studies on Poultry Plague.

Dr. W. PFENNINGER and Dr. E. METZGER. *Schweizer Archiv für Tierhailkunde,* Zurich, p. 2. January 1926.

In the year 1925 there was a considerable outbreak of poultry plague in Switzerland. The circumstances are evidently connected with the importation of poultry from Upper Italy, where in the previous spring and summer this epidemic spread very greatly.

Cases of natural and experimental poultry plague are described in detail.

Poultry Diseases Again.

Journal of the American Veterinary Medical Association, Vol. LXVIII. No. 5 p. 543. February 1926.

All of the papers of this number are devoted to avian diseases, which are dealt with in the following articles:

Fowl Pest in the United States by J. K. MOHLER, Washington.

Fowl Pest by E. STUBBS, Harrisbury.

Infectious Bronchitis of Fowl, by J. K. BEACH, Berkeley.

The etiology of this disease has not yet been determined. It is really transmitted to healthy fowls by the introduction into the trachea of material from the trachea of an affected fowl.

Chicken-pox virus is sometimes present in the exudate of the larynx and trachea of diseased birds. The importance of this virus in the etiology of the disease however is not definitely determined. Lesions very similar to those of infectious bronchitis were produced in one of two fowls inoculated by the introduction of chicken-pox virus into the trachea.

Avian Haemorrhagic Septicemia by J. W. PATTON.

Studies on Salmonella pullorum, by E. REBRASSIER.

Conclusions (1) In the identification of *S. pull.* it is essential in addition to studying its special morphological characteristics, to ascertain its fermentation activities in dextrose, mannite, lactose and maltose.

(2) There exists an interagglutinability between *S. pull.* and other intestinal organisms. It is not safe, in applying the agglutination test for *S. pullorum* infection to use a titre lower than 1-100.

(3) The results obtained in the interagglutinability of *E. sanguinaria* aod *S. pullorum* indicate that the agglutination test for the latter is not specific, as serum from *E. sanguinaria* has a high agglutinative titre for *S. pullorum* antigen.

(4) It is evident that the blood of chickens normally contains agglutinins for *S. pullorum.* The normal agglutinative titre is 1-10.

(5) The so-called pseudo-agglutinations in the application of the macroscopic agglutination test for S. *pullorum* infection can be controlled by use of antigens which have no phenol added as a preservative.

Neuritis in chickens by L. P. DOYLE.

Summary : In this disease we have a definitive affection of the nervous system which usually produces recognizable gross lesions. The nature of the specific cause is still obscure. Injection and feeding experiments gave negative results during the periods of observation.

Studies in transmission of bacillary white diarrhoea in incubators, by HINSHAW, UPP and MOORE.

B. Aertryche infection in canaries and parrots by T. K. BEAUDETTE.

B. Aertrycke as the etiological agent in a disease affecting squabs by T. K. BEAUDETTE.

Plan for handling avian Tuberculosis, by T. E. MUNCE.

An Oubreak of Fowl Cholera by A. K. GOMEZ.

Poultry World Annual 1926.

The Poultry Press Ltd. Link House, 54 Fetter Lane. London E. C. 4.

A very interesting book with good illustrations and a long list of articles by specialists. It contains the following articles :—

The Poultry Yard, Month by Month.
Leg Colour and Quality in Exhibition Stock.
Buttercups in the Backyard.
The Old English Pheasant Fowl.
The Sussex Fowl.
Hygiene and disease.
The Black Minorca.
The Beautiful white Plymouth Rock.
The early Baby chicks.
Feeding for Eggs.
Growing the laying Pullets.
Tuning up the Poultry Runs.
Pullets on free range.
Whence comes the Chick ?
The Management of Poultry during Hot Weather.
Turkeys as farm stock.
When the eggs begin to fail.
Which are the best layers ?
Keep down the red Mite.
What sprouted oats mean to the egg producer.
Growing healthy chicks.
Milk as Food for chicks.

A complete Treatise on Aviculture.

V. PULINCKS-EEMAN. Brussels. Chasse et Peche. Avênue de la Toison d'or. 1922.

A monograph on the principal breeds, giving to breeders special knowledge for acquiring the best breeding birds and information on breeding so

as to obtain the best results. A book with very fine coloured illustrations.

Poultry Breeds Illustrated.

V. PULINCKS-EEMAN. Chasse et Pêche. Brussels, 1924.

This third edition gives, in addition to all the standards of the breeds represented, a description of breeds which have recently come into favour with poultry breeders.

In a large number of pictures the artist has not confined himself to drawing the sketch of the bird represented, but has indicated the principal details of the markings and patterns.

Contribution to the Digestibility of Albumen in Poultry.

REATZ. Arbeiten der Lehr- und Versuchanstalt für Geflügelzucht, Halle a. d. Saale Cröllwitz, Prof. Dr. Römer. *Deutsche Landwirtschaftliche Geflügelzeitung*, 28th year, No. 46, 13 August 1925.

KELLNER established the prime importance of the digestibility of feeding material dealing only with cattle, LEHMANN with pigs. Poultry conditions were not much considered. Experiments in food assimilation by poultry did not take place until the end of the last and the beginning of this century, when undertaken by LEHMANN, VOLTZ, DIETRICH, and especially LÖSSL. Figures of digestibility of a few foodstuffs:

	According to KELLNER for large cattle	According to LÖSSL for poultry
Wheat	80 %	26.67 %
Maize	83 %	24.10 %
Barley	77 %	14.92 %
Oats	79 %	18.64 %
Soya Bean	94 %	36.05 %
Fish-meal	92 %	91.90 %
Meat meal	97 %	82.35 %

Experiments on the digestibility of albumen with shredded oats, dry yeast and dry buttermilk with fowls:

The oats albumen shewed	36.12 %	digested
The dried yeast albumen	42.68 %	»
The dried buttermilk	74.66 %	»

Dried yeast and dried buttermilk did not prove so digestible for fowls as fish-meal and meat-meal.

Type and Size of Fowls (Italians, Brahmas and Game-birds).

RICHARDSEN. *Deutsche Landwirtschaftliche Tierzucht*, No. 2, p. 4, 1926.

In judging the illustrations of animals made to show individual breeding performances, especially for the continuous determination of the status of

the breeds, in various spheres, in the technical journals, which are used in all directions and accessible to all breeders, the observer can only satisfactorily grasp the type. In particular, type builders, without numerous particulars regarding the sizes and weights of the animals concerned, can only imperfectly realise their object.

The second Annual International Poultry Blue Book. An International Summary of Egg-laying Contests of the World, during the Contests Year 1924-1925.

W. E. ROBINSON. *The Edward F. Hartmann Co.* Springfield, Illinois, 1925.

To make egg laying contests valuable there must be opportunity for intelligent comparison. This can be accomplished only by standardisation. Canada has set the pace and it is to be hoped that all other countries will conform. Housing, rations and management can well be left to each contest and would in effect bring about a contest of contests.

The rule is followed of reporting the best 20% of the pens and an equal number of best hens without reference to breed in each contests. Also a report is made of the best pen and best hen of each breed not having a representative among the high producers.

Experiments on Close Inbreeding of Poultry.

FREIIN VON SCHLEINITZ. *Deutsche Landwirtschaftl. Geflügelzeitung*. No. 44, 1925.

Six strains were examined for brooding capacity, mortality, growth, egg production, maturity and propagation. The following results were arrived at:—

(1) Brooding capacity: By inbreeding the brooding capacity declined in all 6 experimental strains. The brooding capacity of the parent stock amounted to 79 %; after 3 generations of brother-sister inbreeding it was only 22 %.

2. Mortality: Inbreeding probably increases not only the mortality of the young stock but also that of the older stock. The reason is in general the smaller life capacity, partly also the great reversion to ancestral illnesses, and an increase of hens showing the results of recessive inherited factors of specific abnormalities, such as prolapse of the oviduct.

(3) Growth: The rate of growth sank both for the inbred and the control chickens.

(4) Egg Production: Yearly produce of the parent strains 152. In the first generation of the brother-sister inbreeding there was a decline in productivity in all the 6 strains, about 57% of the average of the parent. The winter egg production of the inbred strains sank from 32 eggs in the parent generation to 5.7 in the second. With the control animals the winter egg production remained constant at about 18 eggs.

(5) Maturity: The close inbreeding caused a great decline of fertility in the case of the mated fowls, which does not occur in the same animals in the absence of inbreeding; we here encounter a retardation of the development of the embryonic life.

The economical significance of German Poultry Breeding.

DR. G. SCHÖNBORN. *Berliner Tierärztliche Wochenschrift*, p. 159, No. 10, March, 1926.

Until 1900 poultry was not counted in the general census of cattle, and was not valued very highly. It is now recognized as of economic importance from the State's point of view, and Germany cannot do better than make use of American experience, and adapt it to German conditions. The Americans have shewn that continued calculations are the starting point in poultry keeping. In Germany also a tireless energy is being displayed in the economical perfecting of poultry breeding.

The exact knowledge of American working methods introduced after the war, partly by the return home of German-Americans, has had a great influence on poultry keeping. The poultry breeder demands protection for the home egg trade against foreign dumping.

The organizations are mentioned which are devoted to the furtherance of poultry breeding in Germany.

Simultaneous Infection of a Bird by 17 species of Intestinal worms.

K. J. SKRJABIN. *Comptes rendus de la Société de Biologie*. Vol. XCIV, No. 5. p. 307, 1926.

The writer has up to the present time made 6500 dissections of different birds at the helminthological laboratory at Moscow to enumerate the fauna of parasitic worms. He found at Novotscherkassk (Don) in a drake killed in October 1919 the following species of intestinal worms :—

A. Nematodes.

1. *Schistogonimes varies* Br. 1 in the rectum.
2. *Prosthogonimus* sp. Br. 1 in the rectum.
3. *Metorchis xanthosomus* Crzil. 1 in the duodenum.
4. *Bilhorziella polonica* Row. 5 in the blood.
5. *Eschinostoma revolutum* Tröhl. 3 in the small intestine.
6. *Strigea gracilis* Tröhl. 51 in the small intestine.
7. *Trachophillus sisovi* Sky 2 in the trachea.
8. *Fimbriaria fasciolaris*, 56 in the small intestine.
9. *Hymenolepis carcnula*, 38 in the small intestine.
10. *Hymenolepis compressa*, 24 in the small intestine.
11. *Hymenolepis anatina*, 2 in the small intestine.
12. *Hymenolepis collaris*, 3 in the small intestine.
13. *Amidostonum anseris*, 3 in the cuticle of the gizzard.
14. *Echinuria uncinata*, 16 in the tumours of the ventricle.
15. *Tetrameres pisipinus*, 7 in the ventricle.
16. *Capillaria anatis*, 3 in the caecum.
17. *Polymorphus minutus*, 4 in the rectum.

In all 251 specimens.

Which breeds of poultry in their present standard form ensure high egg production ?

SWEERS, RECKHARDT, ULRICH, ROMER, WEINMILLER, JESS, WIENINGER, MEYER, *Deutsche Landwirtschaftliche Geflügelzeitung*, No. 18, 1925.

The laying type demands of a hen in the first place a roomy body. The breast and egg area should therefore be deep, the back be horizontal, and not fall towards the hind part. In the laying type the distance of the pelvic bones from the breast-bone, and of the pelvic bones from each other is wide, in the useless type on the contrary it is short. In Germany the following have proved the best layers: American Leghorn, followed by Rhinelanders, particularly where the hens possess a good laying build and consequently guarantee a good output, then the Westphalian " Totleger " whose producing form, in spite of the sporting breed, still remains true to type. Brackels and Moewen are already too easily bred, Wyandottes have suffered loss in laying capacity through too much crossing with game birds. To-day two directions of breeding stand out, namely, the game type, ball shaped, similar to the Orpington, and the useful type with slender but nevertheless deep carcase. Rhode Islands and also Sussex to some degree have shown themselves to be good layers. Orpingtons have altered considerably through climatic influence in East Prussia, having become lighter and similar to Rhode Islands.

On the Agglutinative Relationship of Hen Typhus Bacilli towards Human typhus Bacilli.

GIICHI TAKAYANAGI. *Centralblatt für Bakteriologie*, I Section Original, Vol. 98, No. 1-2, 1926.

Summary.

(1) Hen typhus bacilli agglutinate very strongly in typhus serum, often up to titration.

(2) Still, it was observed that amongst many typhus sera, there were some which hen typhus bacilli could not agglutinate.

(3) Typhus bacilli agglutinate in hen typhus serum as strongly as homologous bacteria. Nevertheless I found amongst typhus species some which would not agglutinate in them at all.

(4) If animals were previously treated with the first species, then sera were obtained which influenced hen typhus very strongly, up to titration. On the other hand, sera were obtained which did not affect hen typhus bacilli at all, when rabbits were previously treated with the latter species of typhus bacilli.

(5) When during the immunization of rabbits with typhus bacilli, hen typhus bacilli were examined often for agglutination, it was seen that hen typhus bacilli react more strongly at the beginning of the immunization in comparison with the main agglutination than at the end.

(6) Consequently I may well assume that the above observed fluctuation of agglutination of hen typhus bacilli in typhus sera is caused on the

one hand by the individuality of the typhus bacilli species, and on the other hand by the method of immunization.

Poultry Notes.

ALFONSO TUASON. The Government of the Philippine Islands. Manila, 1924.

One of the most important reasons why the Philippine chicken is of small size, a very poor layer, and lacking in uniformity is the fact that good fowls are not selected for breeding. TUASON here gives his pamphlet hints for the improvement of poultry keeping. He describes selection of male and female birds, proper feeding, etc. These points are especially valuable for the tropics. A short description of the most common diseases and some good drawings are also given.

Research on the Prevention and Treatment of Diphtheric Variola in Birds.

M. Y. VERGE. *Revue Générale de Médecine Vétérinaire*, Toulouse, Vol. XXXV, p. 65.

Avian diphtheria, contagious epithelioma and oculo-nasal catarrh are all the same disease and are caused by a single ultra-virus. The virus can be cultivated in vitro in symbiosis with the cellular elements. It is therefore a cytotropic virus which has an elective affinity for tissues derived from the ectoderm :— skin, nervous systen, buccal and nasopharyngeal mucous.

An intrinsic pathogenic value had for a long time been attributed to secondary germs, but an experiment of VALLÉE and CARRÉ shows in favour of the process that reproduction was able to bring about. These writers indeed have noted that a culture of staphylococci is capable of absorbing aphthous virus, and being then inoculated on a new and sensitive subject the culture gives foot-and-mouth disease. That fundamental experiment throws quite a new light on the pathogenesis of infectious diseases. At least it shows our previous errors in attributing to a visible germ a pathogenic value which did not really belong to it. The writer has never encountered a natural immunity, though birds cured of the disease have acquired a real and lasting immunity.

The immunity as in other *neurotropic ectodermoses* proceeds by stages. Sometimes the immune organism behaves as a germ carrier.

The neuro-vaccine may grow in the testicle, the ovary and more raraly the lungs at a time when the skin and the brain have already acquired a refractory condition. The immunity conferred by the disease lasted in the experiments for at least a year. The writer has searched for the presence of anti-bodies in the blood of fowls vaccinated or cured of the natural disease. It was impossible to prove the presence of anti-bodies. VERGE took for virus intended for the preparation of vaccine the variolic nodules and combs taken from young cocks experimentally infected by virulent inoculation in the axillary vein and virulent smearing of both sides of the comb previously scarified.

The tumours are pounded and the emulsion is filtered and the filtrate is added to a phenic solution. The vaccine is injected intra-dermically or under the skin of the wing.

Immunity begins towards the 17th day following vaccination, it is firmly established from the third week and lasts at least ten months.

During the season 1924-1925, 50,000 doses of vaccine were delivered.

The treatment of sick birds requires repeated vaccinal inoculations: the fowls getting the vaccine every 4 or 5 days until cured.

The vaccine acts therefore not only preventively but also curatively. It constitutes an excellent method of treatment and enables a number of birds to be saved which could not otherwise be cured.

Codliver Oil Feeding.

VON VERSEN. *Deutsche Landwirtschaftl. Geflügelzeitung*, No. 42, 1925.

Four weeks before the moult was due, codliver oil was given in capsule form. The plumage was very quickly shed, the health was very good during moulting, laying capacity was not interrupted, the new growth of feathers took place very quickly. The winter production of eggs increased. During the rearing season in the spring however moulting again took place, as the doses of codliver oil were not given. After the introduction of codliver oil feeding, moulting ceased immediately, and laying capacity began again, Fully grown animals receive at most 1 g. per day; more causes disturbances in the organism, encourages moulting in spring, and has disadvantageous effect on breeding results. 1 g. acts very favourably on leg production, breeding, growth and health of the chickens, power of resistance and proof against the weather. It is best to give chickens 14 days old 1 g. for 20 animals, after 5 weeks 1 g. for 15 animals, and so on. Appearance, especially in the matter of glossy feathers, is much improved by codliver oil feeding. Emulsion is not recommended on account of harmful admixtures.

The Sussex.

CLEM WATSON. *The Feathered World.* London, 1926.

An excellent brochure on the Sussex by Mr. CLEM WATSON who is secretary of the Sussex club. The book deals with the subject from the present-day breeder's point of view and the varieties are taken systematically, dealing with Light, Red, Speckled, Brown and Buff Sussex. It contains a detailed description of the standard, illustrated with some plates of feathers and numerous photographs. It gives much general information on mating for the benefit of the beginner and is a standard work upon the breed.

Investigations Regarding Form of Body and Laying Perfomance.

WEINMILLER, Dissertation, Technische Hochschule. München, 1924.

287 animals of various light breeds were measured, and 12 indices drawn up, and these brought into relation with the laying performance. The results were as follows:

A. With light breeds.

1. Animals with relatively deep and wide breast, and animals, which in comparison with their total size possess long carcases, represent the best layers.

2. Animals with comparatively long breast-bone ridge, and great distance of the end of the breast-bone ridge from the os pubis, are good layers.

3. Great distance of the end of the breast-bone ridge from the os pubis, considered by itelf, is no sign of good laying performance.

4. The distance of the two ends of the os pubis from one another should amount to about a third of the width of the carcase of the animal. Animals with a smaller distance are bad layers; the exceeding of this smallest measurement has no connection with an increase of output.

5. The length of the lower part of the leg and ankle has no relation to the output.

B. With heavy breeds correlation between the measurements of the skeleton and the laying performance cannot be recognized.

Communications.

Poultry World Congress. International item for the Press. — Doctor ALWIN PAPPENHEIMER pathologist of the College of Physicians and Surgeons of the Columbia University, known internationally as one of the greatest authorities on paralysis of man and animals, has promised to present a memoir at the World Poultry Congress which will be held at Ottawa from the 27 July to the 4th August 1927. Among other eminent men of science who will present memoirs are Doctor E. E. TYSSER of the Division of comparative Pathology, Harvard Medical School, an authority on diseases relating to protozoa. Doctor D. F. KAUPP of the College of the State of North Carolina, the pioneer of avicultural pathology in America; Doctor B. J. C. te HENNEPE Jzn. of the State Serum Laboratories at Rotterdam, Holland, a famous European authority on poultry diseases; Doctor CREW of the University of Edinburgh, an authority on breeding. The Board of Agriculture for Scotland has announced that three official delegates will be chosen to be present at the coming Congress. Mrs MACIVER a member of the Board will present a work on "Poultry breeding for women" Mrs MACIVER is a great poultry enthusiast and will be eminently competent to deal with this important question.

The Spanish Government has accepted the Canadian Government's invitation to take part in the Congress and an imposing national Committee has been appointed. At the head of the Committee is Excmo. Sr. Professor Don SALVADOR CASTELLO, founder and Director of the Royal School of Aviculture of Spain, who was President of the Executive Committee at the second World Poultry Congress held at Barcelona in 1924. His colleagues will be Don IGNACIO VICTOR CLARIO Y SOULAN, Director of the School of Agricultural Engineering

HARQUES DE CASA PACHECO, President of the Poultry section of the General Society of Animal Husbandry of Spain; Don ZACARIAS SALAZAR, Professor of Zootomy and animal Pathology at the special School of Agricultural Engineering, Don ENRIQUE PERES VILLAMIL, Secretary of the Exhibition of the World Poultry Congress at Barcelona in 1924; Don PEDRO LABORDE BOIS, Secretary of the World Poultry Congress at Barcelona.

The Consul General of Finland in Canada, M. A. RANANHEIMO, will represent the Government of his country at the Congress. In acknowledging receipt of the invitation to take part in the Congress the Government of Finland made allusion to the great importance of the Congress for demonstrating the various phases of world development of poultry keeping.

In accordance with the wishes of the Government the Central Committee of Aviculture of Poland is organizing the participation of that country in the World Congress. Dr. STEFAN KOPEC of the Institute of Agricultural Research of the Government of Poland, at Pulawy, and Professor MAURICE TRYBULSKI, of the Warsaw College of Agriculture, are at present preparing memoirs which they will deliver at Ottawa in 1927.

AGRICULTURAL INTELLIGENCE

GENERAL AGRONOMY

Agricultural Meteorology.

601. **Causes of drought in North-Eastern Brazil.**

S. PAIO FERRAZ, J. De. (Director of the Meteorological Service of Brazil). Causas provaveis das sênas do Nordeste Brasilero. Ministry of Agriculture, Industry and Commerce, Directorate of Meteorology, p. 3-30. Rio de Janeiro, 1925.

Meteorologically, the problem of the strange annual variations of the rainfall in North-Eastern Brazil is of the utmost importance both for students of meteorology in that country and those outside it. The disastrous droughts which alternate in an abnormal manner in the zone between Bahia and Piauhy are known as an effect whose cause however must be attributed to distant zones. For many years the investigation of this anomaly of the North-East has preoccupied students of Brazilian meteorology and for many years also it has been sought to find some satisfactory solution of the problem in normal local data. This stated, the writer describes the mechanism of thé formation of rain and, in greater detail, the more common and fundamental process based on the theories of BJERNKENES (father and son), of SOLBERG and BERGERON, who have shown the behaviour of low strata of the air (in cases of local depressions and disturbances) due to their super-saturation. According to the unanimous opinions of meteorologists the direct cause of rain is adiabatic cooling. The writer explains the three cases (fig. 1, 2, 3) which occur most frequently, the first of which is common throughout Brazil. In the first case, the moist currents are obliged to rise when they meet with a mountain, being cooled by expansion and therefore lightening themselves of aqueous vapour which they can no longer hold. The second case takes place by the rising of a warm moist current in consequence of the arrival from below of a cold current. In Brazil this occurs on occasions of irruptions of anticyclones, when cold winds disturb the super-saturated surrounding atmosphere of the depressions. The third case relates to a warm moist current overlying cold air. In Brazil this is found in the region of the extreme south, in special conditions of vertical movements, connected with systems of low pressure

After some consideration of the previously mentioned cases, the writer examines the pluviometric map of Brazil (fig. 4), observing first of all that, generally speaking, its distribution has the usual characters. The greater rainfall coincides, as is seen, with elevations or with the zone subject to the equatorial pluviometrical regime, while the low coastal zone with heavy rainfall of the whole Atlantic littoral of Brazil is notable. The factors of some regions are then investigated, the writer insisting specially on BJERKENENS and SOLBERGERG's theories regarding rainfall due to convection currents. Now, what the two Norwegian meteorologists adopt to explain the local rains (" dev veras ") in Norway, due to phenomena of vertical convection, the writer considers to be the great and principal factor of the rainfall of North-East Brazil, manifesting, however, its own influence in other regions also. The writer then maintains that the dryness of the North-Eastern region depends on the vertical gradient of temperature of the atmospheric mass of those regions, affirming that modifications of that gradient are connected with modifications in the cold higher air. The demonstration, supported mainly by aërial soundings of the aerological stations of Cuyabà and Franca, tends to connect the problem of the rainfall of the North-East with the trajectories of anticyclones , by which, these being absent or passing much further south, there would be a notable scarcity of rainfall.

Various questions arise relative to the *causa causarum* that is to say to the reasons of such modifications in the atmospheric circulation, across the South-American continent, but it is not possible to satisfy the many questions which arise on this point, as they are connected with and dependent on problems of world wide meteorology. To solve in a satisfactory manner the problem of drought in North-Eastern Brazil, it would be necessary to discover the reason of the absence or deviation of the anticyclones ; this being done, it will be very easy to foresee the dry periods. And the writer, who energetically and most competently directs the Brazilian Meteorological Service, is confident of obtaining this result, when, the national system extended and the indispensable correlations between the observations of the whole world (desired and already requested in various meteorological conferences) obtained, it will be possible to deduce in rapid synthesis the mechanism of the atmospheric circulation of the whole globe and follow its progress and variations, deducing the factors which can be applied to all branches of civil activity. A. F.

602. **Solar Radiation Recorders.**

HAMES, W. B. (Soil Physics Department, Rothamsted Experimental Station). *Quarterly Journal of the Royal Meteorological Society*, Vol. 51, No. 214, pp. 95-100, 2 fig. London, 1925.

The author gives a brief outline of the results obtained by a comparison of the radiation records at Rothamsted. The different apparatus in use in most stations do not give comparable results, which constitutes a serious obstacle to the systematic study of radiation, the key-stone of

meteorological science and of its practical applications. Hence, the comparative study undertaken at Rothamsted forms a valuable contribution. WILSON's radio-integrator and CAMPBELL-STOKE's Helio-phanograph have been used for many years but only since 1921 has it been possible to establish averages and to discuss data. In 1921 the Physiological Plant Institute of the Imperial College established a Callendar and the results given by this apparatus were considered the base for comparison with others. CAMPBELL-STOKE's helio-phanograph is too well known to need description. WILSON's radio-integrator is formed by two connected bulbs of empty glass, one of which contains coloured alcohol and remains in the sun; the other lower one is however protected on all sides. The sun's rays falling on the first bulb cause distillation of the liquid into the lower tube which is properly graduated. The volume of the liquid thus obtained gives the total measure of the radiation encountered. The Callendar apparatus has a receiver formed by two platinum resistances contained in a glass tube. They are rolled up over a horizontal strip of mica and one of the resistances is blackened. The whole thing acts as the resistance thermometers; the changes of temperature being determined by the quantity of radiation received. The first resistance absorbs the whole radiation while the other reflects it entirely.

A continual registration is obtained by connecting these resistances by a Wheatstone bridge to a self-registering duly standardised system. In the diagram (fig. 123) the data yielded by the 3 apparatus since 1 April 1922 are given for each week. The daily data were always from sunrise to sunset. The study made on the Callendar being the only one absolutely self-contained, it became necessary to use certain conventions for reading the other instruments. A factor was therefore given for use in reading each apparatus so as to obtain from them all the same value during a given period of intense radiation (clear summer weather). As may be seen by the diagram, WILSON's radio-integrator gives much higher results during the summer than at any other time and much lower results during the winter. The hours of sunshine taken as a base of the whole radiation give on the contrary far higher results during winter months, owing to the fact that an hour's sunshine is given the same value irrespective of the time of day or year. Dr. ÅNGSTRÖM has always used a very simple formula for calculating the effective whole radiation in view of the hours of sunshine namely: $Qs = Qo\ (.25 + .75\ S)$.

S shows the relation between the present power of sunshine hours and its possible maximum for a fixed period of the year.

Qo shows the maximum of the radiation for a clear day and

Qs the required value of the whole radiation.

ÅNGSTRÖM judged this formula very suitable when the data were taken (at Stockholm) for a period of at least one month. Without any change it was applied to the data taken at Rothamsted and the following table shows its precisions. The numbers express the difference in percentage between Qs as it was noted with the Callendar and Qs as it was noted with the above mentioned formula. The table gives the results of

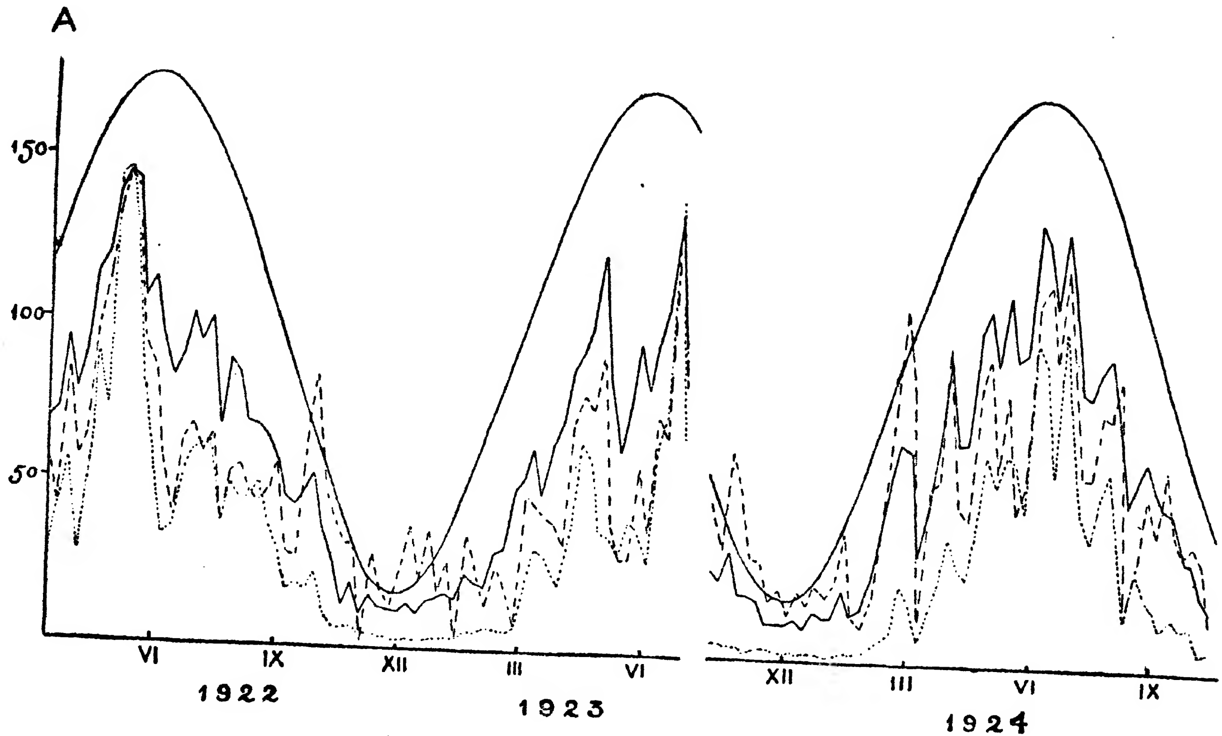

FIG. 123. — Radiation Records at Rothamsted.
- - - = Callendar Recorder.
——— = Hours of Sunshine
. . . . . . = Wilson Radio-integrator.
A = × 100 Joules per cm² (per week).

a whole year with some extra values taken from some months of other years.

January = 17.
February = 15.
March = 18.
April + 4 — 13 + 9.
May = 11 — 11 — 5.
June + 5 — 12 — 5.
July — 9.
August — 15.
September — 8.
October — 1.
November O + 22.
December — 9 + 22.

The total variation agrees with that found by ÅNGSTRÖM. An examination of the above table shows that the general tendency of ÅNGSTRÖM's formula is to give too small values to the Rothamsted figures.

WILSON's radio-integrator is held to act with an equilibrium approximating to that of surrounding objects. When a quantity of heat dQ is received by the higher bulb in a dt and T 1 and T 0 time the temperature of the bulb and of the surrounding objects is respectively :

$$dQ = l\,dw + A\,(T_1^4 - T_0^4)\,dt$$

in which the first term gives the quantity of calories used for evaporating a weight dw of liquid and the second term the quantity lost by irradiation. Given that the volume of the distilled liquid has to be a direct measure of the radiation received the second term might be neglected. But this cannot be a likely case because the difference of temperature (and therefore of the steam pressure) between both bulbs is a necessary condition for the distillation of the liquid from the first into the second bulb.

The lower bulb may be considered to have the same temperature as the surrounding objects. For the purpose of experiment, three days of the same month were chosen for obtaining a low, an average and a high radiation value.

Calculations were made from the Callendar data and the dimensions of WILSON's bulb on the volume of alcohol that ought to have evaporated daily if there had been no losses. The values obtained were respectively 16 = 8 and 3 times the volume collected in WILSON's radio-integrator.

We can therefore conclude that the loss by irradiation is always considerable but especially so when the quantity submitted to irradiation is smaller.

This seems at first nonsensical because the difference in the steam pressure that causes the distillation of the liquid ought not to follow so quickly on the increase in the change of temperature as the loss due to irradiation. But we must not forget that at high radiation values the objects surrounding the bulb remain warm while the bulb itself is cooled by the evaporation in it which is always noticeably inferior to the loss by

irradiation. The dissipation of the heat in the alcohol contained in the lower bulb becomes on that account a very important factor.

A correlation diagram shows that WILSON's radio-integrator can give quite valuable measurements in comparison with those obtained with Callendar's apparatus. The curve traced is a parabola having the following equation :

$$C = 1057 \sqrt{w}$$

in which C is given by the Callendar's instrument in joules per cc and W by WILSON's radio-integrator in cc.

On the whole, although new elements may displace the above mentioned data of comparison — especially with average temperatures given for longer periods — and despite the objections raised against its data as being impossible to compare with those given by other instruments of the same sort, WILSON's radio-integratior is obviously in good enough agreement in its data to the Callendar. Considering its great simplicity and the exactitude of the observations obtainable with the correction formula, this is an instrument that deserves to be better known and used especially in the ecological stations where the study of solar radiation becomes day by day more important. A. F.

603. **Transmission of meteorological-agricultural data by means of radiotelephony**

SANSON, J. Téléphonie sans fil et prévisions agricoles. *La Vie Agricole et Rurale*, Vol. XXVI, No. 13, p. 209-211. Paris, 1925.

Radiotelephony apart from its other uses has become a powerful means of rapid diffusion for meteorological news which may be useful to agriculture. It is already three years since the Ministry of Agriculture in France, in view of the progress made both in the field of meteorology and that of radiotelephony, recognized that it ought to be utilized in the field of practical agriculture. Consequently, in a circular to the Prefects, the Ministry itself intimated that consequent on news coming in from all parts of Europe four times a day to the Central Bureau of Meteorology, the latter was in a position to send out probable forecasts valid for the following 18-24 hours. Four times daily the Eiffel tower, at stated hours, sends out a message which can be picked up within a radius of 500 km. by all stations provided with a galena receiver. Having received the message, the telephone station, to diffuse the details, makes use of a bell adopting conventional signals. Three strokes indicate rain, six frost, ten a storm, a hurricane or hail. The absence of signals indicates that no change of weather is expected. One of the most effective provisions for the practical diffusion of this method, the multiplication of radiotelephonic receiving apparatus, has been the suppression of the fiscal tax so that a farmer now, with the greatest ease and a minimum of expense, is in a position to prearrange work and all other cultural practices on the basis of weather reports which are transmitted to him. It is needless to stress the economic advantage. Moreover, the installation and utilisation of a radiotelephonic

station does not require any special knowledge and is very easy to set up. It consists of three parts :— (*a*) An antenna ; (*b*) a receiving apparatus (detector and electric listener) ; (*c*) an earthing arrangement. The article indicates the processes generally used for the construction of a despatching installation, enlarging especially on two types of antennae internal and external, the latter commoner than the former ; it also indicates the parts of the receiving apparatus :— detector with crystals and valves with three electrodes. Finally it gives a brief explanation on earthing. A. F.

604. **Botanical Analysis of Cultivated Pastures.**

ELLINGBØ M. *Meldinger fra Norges Landbrukshøiskole*, Nos. 2-3, pp. 113-145, tables 4, bibliography. Oslo, 1925.

The importance is evident of judging the value of a pasture from a nutrition point of view, the obtaining of information as to the quality of the herbage, and for deciding upon the best cultivation treatment of a grazing land.

Such investigations are carried out by means of a botanical analysis, and many methods have been tried, the most successful of which is that of Prof. LENDE-NJAA, devised in 1923, which estimates the percentage of the different plants of the crop.

The great advantage of the method is that it is quick and sufficiently exact, and that it controls and trains the estimating ability of the investigator.

Plots are selected, each 0.5 sq. m., the number being in relation to the size of the field. Botanical analyses should be made at least once a month.

The exactness of the method depends upon the estimating ability of the investigator, the number of plots in relation to the area, and the suitable distribution of plots. W. S. G.

Agricultural Botany, Plant physiology and chemistry.

605. **A bioenergetic law in plants.**

TERROINE, E. F., TRAUTMANN, S. and BONNET, R. Loi bioénergique de la formation des hydrates de carbon aux dépens des protéiques et des graisses chez les végétaux. *C. R. de l'Académie des sciences* v. 180, No. 15, p. 1181-1183. Paris, 1925.

During germination in the dark and in distilled water, a process which consists almost solely in the formation of cellulose at the expense of the reserve of the seed, the gross energy yield varies in proportion to the reserve, being high (72 %) in seeds rich in starchy matter (rice), weaker (65 %) in those with smaller quantities of starch and larger quantities of proteins (lentils), and decreasing to 53 % in seeds composed of a mixture of proteins and fats (ground nuts).

On the basis of these facts, the conclusion is arrived at that, in the seeds investigated, the formation of hydro-carbons entails a considerable

loss of energy if it takes place at the expense of proteins, and that it is still large, but less so if it takes place partly at the expense of the fats. Extending the researches to other seeds, it was seen that there is a general law and that the values obtained by calculation are fairly close to those obtained experimentally. By which the following law may be formulated that, *in plants the transformation of proteins into hydro-carbons is accompanied by a loss of* 35 % *of the metabolized energy and that of fats by a loss of* 23 %. A. F.

606. **Contribution to the knowledge of the influence of acidity on the growth of plants.**

NEMEC, A. and DUCHON. Prispevek k otazce vlivu acidity na vzeust restlin. *Zpravy vijzh, ustavu zemedelskych* no. 8, Ministry of Agriculture.Prague, 1925.

Waterculture experiments made on maize and blue lupin for the study of the influence of the nutritive medium's reaction on the plant lead us to th following conclusions : the development of plants, cultivated in the artificial medium of nutritive solutions, depends on the reaction of the liquid, and this is an important factor in growth.

As the concentration of the hydrogen ions ascends, plants seem to show a tendency to accumulate the mineral products in their leaves and roots. The optimum reaction of the nutritive surroundings for the growth of plants is ruled by the stage of development of the plant in question, in which the hydrogen ions in the solution play their part.

If the acidity of the liquid surroundings starts its influence at the beginning of the germination of the seed, the optimum return corresponds to a feebly acid reaction of pH = 6.0. Maize plants first raised in normally nutritive surroundings and later on, in an advanced state of development, put into liquids of varying degrees of acidity, show a maximum growth at a higher acidity of pH = 5.1. Finally by letting the nutritive solutions of different degrees of acidity act upon the plants when fully developed the most favourable growth is shown at a reaction of considerable acidity pH = 4.0. Moreover we find that the acidity tallying with optimum growth for a lupin grown all the time in the same solution is less — pH = 6 — than that for one introduced at a later stage of development — pH = 5. Whereby we see that the germinating grain is much more sensitive to the acidity of its medium than more advanced plants.

With the progressive development of the maize plant, the optimum growth reaction tends towards a higher concentration of H ions, so that the optimum acidity index of grown plants corresponds to a fairly high H ion concentration. The reaction of the nutritive medium undergoes important changes during plant growth. It is interesting to note that these changes tend to force towards or even to stabilize the reaction of the nutritive solution at a certain fixed concentration of hydrogen ions. However these changes in reaction only take place as long as the degree of the acidity of the liquid exercises a toxic influence on the organism of the plant.

In short our experiences teach us that the living plant possesses a

certain power for regulating the reaction of the medium in which it grows, which is able to change an unfavourable concentration of hydrogen ions into one more favourable for the growth of the given variety.

607. **The Relation of Root Growth to Oxygen Supply in the Soil.**

CANNON, W. A. *Ecology*, Vol. V, No. 4, pp. 319-321. Brooklyn, 1924.

The writer in making water extracts of soil, considers two factors of special importance (in all surroundings and for all species of plants) namely, the temperature of the soil and the quantity of oxygen supplied to the roots.

As is known, a variation of temperature, the other factors remaining equal, causes an immediate variation in the amount of growth of the roots.

Similarly it may be said that variation in the partial pressure of the oxygen in the soil air (being low) produces similar results.

In his note, the author aims at defining two points in the temperature-oxygen relation of the roots namely: — how an increase and decrease of temperature can modify the amount of growth of the roots themselves, in the presence of a low partial pressure of oxygen; secondly, the actual correlation between the quantity of oxygen required to produce certain amounts of root growth and the capacity of absorbing oxygen by soil water at a given temperature. Deficient oxygen is a limiting factor of root growth at any temperature and in a ratio which is characteristic both for temperature and species. For this reason from this point of view, an expression which would define the amount of growth in relation to temperature and oxygen supply would be very desirable. For this purpose the ratio of growth and the relative growth connected with the two factors may conveniently be used. This may be defined as the amount of growth observed at a given temperature and in respect of a given partial pressure of oxygen (*r*) divided by a certain amount of growth at the same temperature but in normal conditions of aeration (R) namely $\frac{r}{R}$

It has been found that, at least up to a certain degree, the relation of growth may be characteristic for a given species. That defined, such relation seems to have at least two notable characteristics. In certain constant conditions of low pressure of oxygen, its value varies inversely with the temperature, while at constant temperature, its value varies directly with the partial pressure of the oxygen because the latter is small. In the few instances which follow from the first of these characteristics, it may be noted that only the temperature varies, further note that in all the experiments in which the oxygen is shown in percentage, it is understood that the mixed gas is nitrogen and that the reference is to volume.

With *Allium Cepa* using 1.6 % of oxygen the ratio of growth varies between 0.6 and 0.9 at 16° of temperature (C.) and from 0.8 to 0.25 at 21°.

Citrus medica with 2.8 % of oxygen has a ratio of about 1 at 23° and about 0.6 at 27°.

With *Zea Mais*, with 3 % of oxygen the ratio is about 0.35 at 17°

and about 0.06 at 30 degrees. It was however observed with these three species that the root growth decreased as the temperature increased. It is also clear that specific differences exist, as is shown by the reactions, between the quantity of oxygen in relation to the temperature.

Similar reactions were obtained with *Opuntia versicola*, *Pisum sativum*, *Gossypium hirsutum* and *Potentilla anserina* and may consequently be accepted as representing the usual relations of the root system. Returning to the consideration of variations in growth consequent on changes in oxygen, the temperature being constant, the author mentions the following results.

At 20° with *Prosopis velutina*, the ratio of growth is 0.14 with 0.06 % of oxygen, 0.33 with 0.8 % of oxygen, and 0.71 with 2.2 % of oxygen. *Zea Mais* at 17° gave 0.66 with 3.6 % of oxygen and 0.98 with 1 % of oxygen.

For *Citrus sinensis*, at 27° the ratio is 0.6 with 0.8 % of oxygen and 1 or normal with 1.2 % of oxygen. Similar results were observed in other experiments, from which it appears that the condition reported is general. Two points may be noted — firstly, diverse relations were established in roots with an equal supply of oxygen, when, however, the latter was in very small quantity, in which case as was observed previously, there may be specific relations. Secondly what constitutes a *small* supply of oxygen is purely a relative matter.

Again, such *small* quantities of oxygen may easily coincide with such quantity as the water is capable of holding in solution at various temperatures, varying from 15° to 30° C. A. FÀ.

608. **The dispersion of the endosperms of maize.**

BESSENICH, Fr. Untersuchungen über die Endospermenentleerung von *Zea mais*. *Jahrbücher f. wissenschaftliche Botanik*, v. 83, No. 2, p. 231-272, 7 fig., 16 tab., bibl. Leipzig, 1925.

DAHM, P. Untersuchungen über die Abhängigkeit der Endospermenentleerung bei *Zea mais* von verschiedenen Salzen. *Ibidem*, p. 273-320, 2 fig., 17 tab.

It appears from BESSENICH's researches that the dispersion of the endosperm of *Zea mais* is prevented by sulphate of calcium and is retarded by the H. ions of various acids. Every acid has then a specific action determined by the anions; thus hydrochloric acid has a greater preventive action than that of phosphoric acid at the same pH concentration. The most favourable conditions for dispersion are given by pH = about 5.

The OH ions also have preventive action which is reduced as the neutral point is approached. DAHN has renewed BESSENICH's experiments, improving the technique, in such a manner that 80 % of all the investigations remained unaffected by bacteria. The quantity of sugar evacuated (which in many experiments attained 80 % of the maximum quantity possible of the starch content) is subject to considerable variations even between the grains of various plants of the same race. The experiments are only comparable between the grains of the same plant and are made at the same temperature and with the same duration. Solu-

tions of the chlorides of the alkalies and of the alkaline-earths, in determined concentrations, prevent the emptying of the endosperm. They are here put in order of capacity for so doing: Na, NH_4, Mg, Ca, Sr, K, Ba, Li. Sodium salts in order of capacity for such action are as follows: — sulphate, nitrate, chloride, primary phosphate, rhodonate, tartrate, bromide, borate, carbonate, secondary phosphate, acetate. It still remains however to be proved whether it is a case of simple action of ions.

The endosperm of maize, in a dry state, does not contain any active diastase; for hydrolysis of the starch the aleurone stratum is necessary, which is probably tissue formed by diastase. This function cannot possible be exercised by the *scutellum*.

The reduction of the starch in the endosperm of maize is not a true enzymic process, but the vital activity of the cell is necessary for it. The diastase is diffused in the dispersion fluid. When the latter is caused to act on soluble starch it is seen that certain salts (chloride of barium and of lithium), with 0.1 *molarous* concentration, help the hydrolysis of the starch, preventing however the emptying of the endosperm at the same concentrations. On the other hand, for example, chloride of calcium at the same concentration greatly hinders the reduction of the starch, while it acts rather less than the other salts on the dispersion process.

Inasmuch as the processes indicated should be understood as attached to the vital activity of the cell, it may be considered that the preventive action of the salts is effected either by suspension of vital activity or else by its influence on the permeability of the plasma. F. A.

609. **The Growth of the Cotton Plant in India.**

INAMDAR R. S. SINGH S. B. and PANDE T. D. (Benares Hindu University). *Annals of Botany*, Vol. XXXIX, No. CLIV, pp. 281-311, fig. 8, bibliography. London, 1925.

The Authors carried out research on the relative growth-rates during successive periods of growth, and the relation between growth-rate and respiratory index, throughout the life-cycle of the cotton plant.

An investigation of the quantitative analysis of growth in *Helianthus* was carried out by KIDD, WEST and BRIGGS, and it was decided to apply their methods of work to tropical plants in order to evaluate quantitatively the internal and external factors concerned in growth.

The experiments were designed to compare :—

(*a*) The relative growth-rate curves of plants grown in different periods of the year.

(*b*) The relative growth-rates with variations in leaf-weight ratio and the leaf-area ratio.

(*c*) The relative growth-rates on the one hand, and variations in the respiratory indices of the entire plant and of its parts throughout the life-cycle on the other.

Selected seed of the variety *roseum* of cotton were used in all the experiments.

[609]

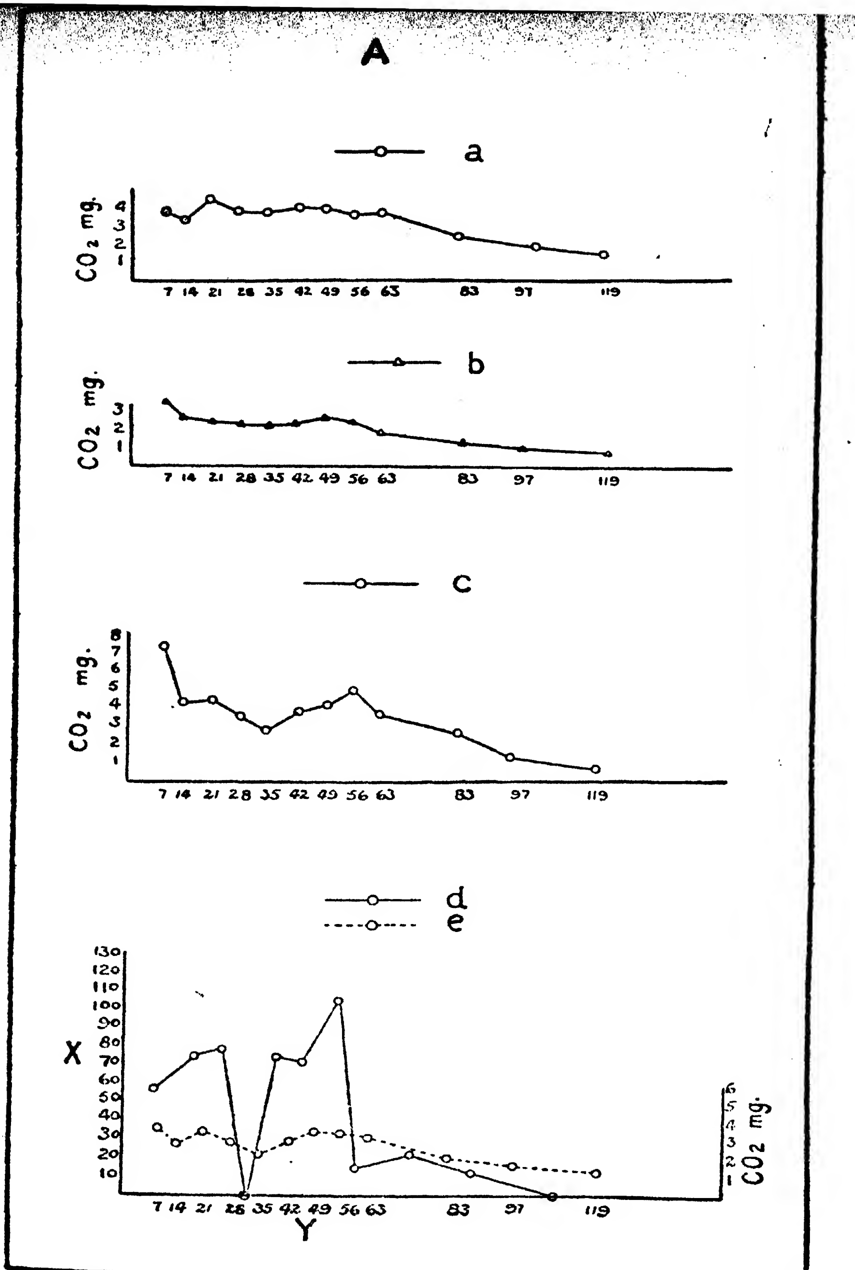

FIG. 124. — *Growth of Cotton Plant in India.*

a = Respiratory indices of leaves.
b = » » straw.
c = » » root.
d = Growth rate.
e = Respiratory indices of whole plant.

Respiration was measured in the laboratory at a temperature of 38° C. Separate estimations were made for roots stems and leaves.

The growth of cotton plants was measured by the dry-weight method, and the relative growth-rate per week calculated on an exponential basis

A summary of the authors' work is as follows:

(1) The growth-rate curves show a maximum increase which is reached sooner or later according to the duration of the vegetative period. The shorter the vegetative period, the earlier is the maximum reached.

(2) The growth-rate curves are compared with variations in the leaf-weight ratio and leaf-area ratio. The growth-rate curve is divided into three phases in this connexion:

(*a*) An initial phase when the curve agrees neither with the leaf-weight ratio nor the leaf-area ratio. This may be due to the leaves not yet having attained their maximum assimilating capacity.

(*b*) An active phase of growth when the relative growth-rate curve runs parallel to the curve of either the leaf-weight ratio or the leaf-area ratio. In plants grown in bright weather in the summer, the growth-rate is influenced by the percentage-weight of the leaves, while in cloudy weather the area exposed appears to be the determining factor.

(*c*) In the last phase of growth there is greater decrease in the growth-rate than can be accounted for by the decrease either in the percentage leaf-weight ratio or the leaf-area ratio. This may be due to reduced assimilating capacity of the leaves.

(3) The growth-rate curve is compared with the course of the respiratory index of the plant throughout the period of growth. The course of the respiratory index is found to run parallel to the growth-rate curve, a conclusion which can be extended to the results of KIDD, WEST and BRIGGS on *Helianthus*. The results on the respiratory values of the meristematic tissues differ, however, from those obtained by the three authors. It is concluded that the course of the respiratory index merely expresses the intensity of the series of "protoplasmic activities" which influence growth-rate. It does not seem to have any influence on the decreasing or the increasing of growth.

W. S. G.

610. **Studies in Transpiration of Seedlings of Conifers.** *

PEARSON, G. A. *Ecology*, Vol. V, No. 4, pp. 340-347, fig. 2. Brooklyn, 1924.

In 1919-20, transpiration measurements were made at the South West Experimental Station (Los Angeles) on seedlings of four conifers, natives of the mountain of Arizona and New Mexico. The species selected were the western yellow pine (*Pinus scopulorum*), *Pseudotsuga taxifolia*, *Pinus aristata* and *Picea Engelmanni*.

The habitat zone of the yellow pine is at an elevation of 2000-2500 metres where the average annual rainfall amounts to 22 inches and that of the maximum temperature to 75°F.

The seedlings in question, varying in age from 2 to 5 years, were

*See: BATES Charles C. Physiological requirements of Rocky Mountain trees. *Jour. Agric. Res.*, Vol. 24, No. 2, pp. 97-164, 1924.

PLATE XXXVIII

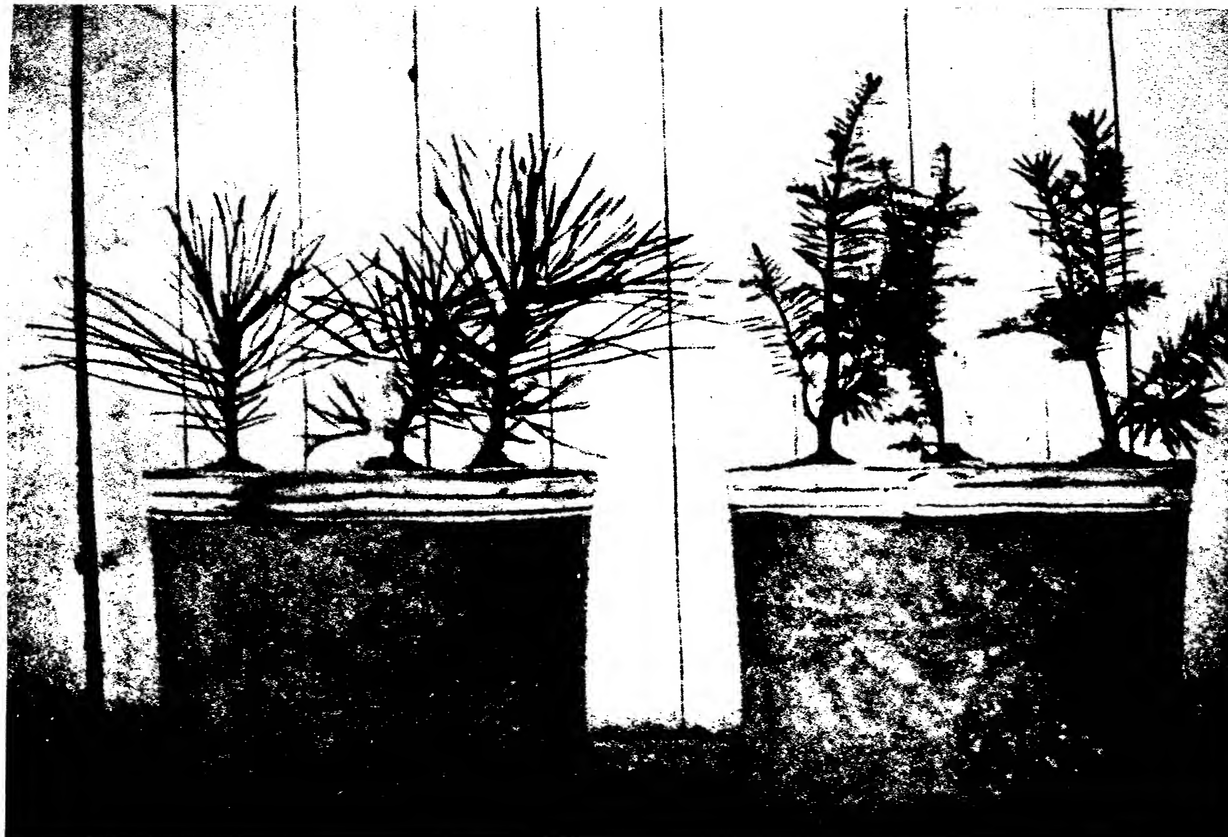

FIG. 125. — *Pinus scopulorum* and *Pseudotsuga taxifolia* in pots prepared for measuring evaporation.

planted in galvanised iron vessels, about 25 cm. high and having an upper diameter of 23 cm. Preliminary experiments had shown that the method of coating pots with sealing wax was unsatisfactory and therefore metal vessels were used.

In the paper cover wrapping at the base of each plant (fig. 25), a one inch hole was made and these holes were closed later by a covering which left a small space round the stem of the plant; these spaces were then closed with clay. Air and water were introduced through a glass tube, the lower extremity of which ended in a cylindrical porous receptacle (LIVINGSTON), perforated at the sides and inserted in the soil. A small glass cap over the free end of the tube served to keep out rain while allowing air to enter. The soil was taken from the surface in a *Pinus scopulorum* forest at the base of the trees themselves. It was sifted through a 3 mm. sieve, of such a mesh as to exclude only the larger material. Preliminary experiments made in the soil of the immediate vicinity had proved the wilting coefficient to be 10.5 %.

After the seedlings were planted in the vessels, water was added to bring the total humidity contained in the soil to 20 %. The gross weight of each vessel with humidity of 20 % was then calculated, and after each weighing, during the period of the experiment, the weight was always brought up to its initial amount. Judging from the growth and excellent development of the root system of all the species, except *Pinus aristata*, it may be deduced that the vessels furnished absolutely suitable conditions of soil.

The interval between the various weighings was varied according to the season; during the spring period the weighings were ordinarily made every 3 or 4 days, but during late autumn or winter the interval was prolonged to a month or more. From about the middle of June to the middle of October, according to the weather, the vessels were taken out of the room in which they were sheltered and exposed to full daylight. They were protected from excessive sunshine by small meshed wire netting. Between the 1st January and the 1st April the plants were kept in a cold, slightly illuminated room.

During the progress of the experiment numerous problems arose which it was desirable to solve completely.

Although transpiration of conifers has been studied by various workers, they have, except in few cases, studied the subject from points of view different from those here presented. The most important of the problems to be solved was to obtain a satisfactory series of data which would enable a comparison to be made of the behaviour of various species. The usual method of considering transpiration on the basis of the leaf surface has been abandoned because it cannot express the desired relation. From a forestry point of view, the various species should be compared by taking into account the quantity of water consumed by trees of equal size and volume.

The tree which transpires less per unit of leaf surface is not necessarily that which consumes less water, since this apparent economy may be more than balanced by a larger leaf surface in proportion to the volume

of the tree itself. The first thought was therefore to obtain a satisfactory basis, estimating the transpiration per *unit of weight*, for each plant.

Seedlings of approximately equal size, will produce closely comparable data both in green weight and dry, but varying the size, age and form of the plants, even of a given species, will, on the contrary, cause confusion in the results. From that it is deduced that there is not a direct relation between the amount of transpiration and the entire mass of the seedling; however, it is evident that some relation ought also to exist. It might be supposed that the transpiration was in some way proportional to the mass of active tissue, but a tree contains also more or less inert wood. As the seedling becomes older the, proportion of live tissue in the entire mass decreases ; it is generally less than 5 %.

A better basis of transpiration is found in the growth.

The increase in dry weight is a direct measure of activity and it furnishes also the proportion of the amount of active tissue existing at any time in the tree. Another problem arises from the fact that some species grow naturally under different conditions and presumably under such different conditions have different requirement to realize optimum development ; on the other hand in order to compare their activity they should all be grown side by side in the same medium. In the experiment here described, all the species were grown in the climate and soil suited to *Pinus scopulorum* and only the species *Picea Engelmanni* in more favourable conditions of humidity.

The commencement of growth was notably accelerated by keeping the plants in a greenhouse during the spring months.

For practical purposes it might be useful to have at disposal various young plants each of which takes the place by itself of the species under consideration and can be grown in conditions absolutely similar to those existing in nature.

Capacity of resistance to drought. — In the course of these experiments interesting observations were made regarding the behaviour of the seedlings in respect to drastic reduction of humidity in the soil. On 10 August 1920, in a series of vessels which previously were kept at a constant humidity of 20 %, or approximately 9.5 % relatively to the wilting coefficient, discontinuous watering was practised on the soil in question. The amount of transpiration immediately commenced to diminish, at the end of the first month, it was in many cases less than 3 % of the normal. At the same time the humidity of the soil decreased in amounts varying from 2 to 5 tenths of 1 % of the wilting coefficient.

During the last two months, the transpiration was almost imperceptible ; the plants of all species showed signs of feebleness indicated by change of colour or drying up of occasional leaves ; however, there was no appearance of wilting. With the coming of cold and snow in the latter part of October, the vessels were sheltered in a greenhouse, but a change in mean temperature from 32° to 54°F. gave no appreciable indications regarding transpiration.

To ascertain which plants were really living, two vessels of *Pinus scopulorum* were watered on the 13th November renewing the humidity in the

TABLE I. — *Transpiration in relation to increase in dry weight.*

Species	Age when planted in vessel	Dry weight gm. Initial (a)	Dry weight gm. Increase in 2 years	Transpiration 1919 and 1920 gm. (b)	Water used per 1 gm. of increase %
Pinus aristata 1	5	7.56	19.89	8.186	412
» 2	5	5.42	13.78	6.465	468
P. scopulorum 1	3	6.03	30.25	11.219	371
» 2	2	2.55	16.69	6.469	388
» 3	2	2.87	22.83	9.771	428
Pseudotsuga taxifolia 1	4	8.76	29.06	10.895	375
» » 2	4	11.07	27.61	10.672	387
P. Engelmanni 1	4	7.14	16.51	5.478	353
» 2	4	7.83	31.33	11.445	365

N. B. — Of the values given above each represents three plants since each vessel contained three seedlings.

(*a*) Calculated from the proportion between green and dry weights of similar plants.

(*b*) The covers for the determination of the transpiration were applied from the 1st July to the 3rd October 1919 and from the 3 March to the 1st September 1920.

TABLE II. — *Wilting coefficients.*

Species	Marly clay soil (1) No. of vessels	Marly clay soil (1) No. of plants	Marly clay soil (1) Wilting percentage coefficient	Prepared soil 0.50 marly clay, 0.50 sand No of vessels	Prepared soil No. of plants	Prepared soil Wilting percentage coefficient
Pinus aristata	4	10	10.56	2	2	6.35
P. scopulorum	4	8	10.55	5	7	5.80
Pseudotsuga taxifolia	4	10	10.30	4	4	6.26
Pinus engelmanni	1	3	10.25	3	3	6.03

(1) The vessels considered in Table 1 form a part of this series.

former proportion of 20 %, and immediately the amount of transpiration increased and the supply of water being maintained, after a month new shoots appeared. During the early part of the following winter the tips of various plants turned brown, but in most cases the greater part of the plants remained fresh, thus indicating a localisation of the excessive lack of water.

As a rule, the younger shoots suffer most. In some vessels single plants remained fresh for a long time after their companions in the same vessel were dried up. In the course of this experiment it was shown that all

the plants were dead by the 8th April, except one *Pinus aristata*, which lived until the month of June. It is not possible to draw definite conclusions regarding the resistance of the various species to drought, except that *Pinus aristata* seems to resist better than the others.

The most important fact ascertained in the course of these experiments is that all the species used have a surprising degree of resistance to transpiration even when the supply of water is reduced to a dangerous minimum.

Capacity of absorption of water from the soil.

The capacity of the plants to absorb water from the soil depends on their osmotic power and especially on their capacity for extending their roots in search of moisture. In the seedling stage a rapid penetration into the depth of the soil is itself an indispensable condition for survival. Experiments made on the wilting coefficients indicate that in this respect no substantial differences exist between the various species respecting the power of absorption of water in the soil. More exhaustive experiments may show more definite differences, but it is certain that these will never be so great as to give any species an appreciable margin over the others.

The study of which we have described the principal parts, is certainly not sufficiently exhaustive to give answers to all the questions considered. However, it proves, as has already been pointed out, that in these species there is a large margin of resistance to lack of water when the soil becomes very dry. As regards the problem of the humidity of the soil, as is indicated by the wilting coefficients, the data collected do not present such differences as to make it possible to assign, in this respect, any marked supremacy of one species over another. The more important results and the standards more adapted for similar enquiries may meanwhile be summed up as follows:

(*a*) The problem of transpiration in the forest is more exactly expressed in terms of loss of water by humidity than in those of increase in dry weight. To determine such increases all plants used in the experiment should be weighed before they are planted in the vessel and a specimen of each class should be selected to determine the proportion of dry matter to green weight. For certain purposes, it may be useful to express transpiration on the basis of leaf surface.

(*b*) There should not be too many specimens in the experiments. Each species should be represented by at most 10 plants; a margin of 25 % should however be allowed for plants which die or grow abnormally.

(*c*) The metal vessels should be at least 15 cm. in diameter and 25 cm. high. In all cases it is preferable to use a greenhouse.

(*d*) There are various problems regarding the relations between the water and the seedlings. Each one requires separate experiments. In addition to those here described there are the relations to transpiration in winter, resistance to high temperature, to the effect of light, of humidity and wind. Each experiment, as is obvious, is concerned with many stages

of a seedling and it is also desirable that it should be carried out in more than one kind of soil.

(*e*) Much care should be taken in the selection of the plants employed. A general want of consistency in plants of the same species and class may affect the value of all data. A. FA.

611. **The persistance of vitamin A in plants.**

COWARD HOPE, K. (Dep. of Physiology and Biochemistry, Univ. College, London. The Persistance of Vitamin A in Plant Tissues. *The Biochemical Journal* v. XIX, No. 3, p. 500-506, 4 fig., bibl. London, 1925.

Vitamin A is not used in any process of the plant living in darkness. It appears to increase when the leaves lose their green colour and become yellow. It is completely destroyed when the leaves wither and die.

It is not diffused to an appreciable degree in water from the end of a cut plant. A. F.

612. **The chemical constitution of the cortical membrane of the potato.**

RHODES, E. (Department of Botany, University of Leeds). The Chemical Nature of the Membrane of Potato Cork. *The Biochemical Journal*, v. XIX, No. 3, p. 454-463, fig. I, bibl. London, 1925.

The cortical layer originates from metamorphoses of fatty substances and always contains a certain quantity of fats which have not undergone change and which are soluble and give to this layer the property of being coloured.

For the most part the layer consists of a complex of fatty acids, relatively insoluble, which yield to prolonged saponification. The non-saponifiable matter contains a considerable quantity of volatile bodies; traces of glycerine are also found in it.

These facts may be of importance in the formation of the cortical layers. A. F.

613. **Ammonia and trimethylamine as odorous constituents of the cotton plant.**

POWER, F. R. and CHESNUT, V. E. (Phytochemical Laboratory of the Bureau of Chemistry, U. S. Dep. Agr.). The odorous Constituents of the Cotton Plant. Emanation of Ammonia and Trimethylamine from the Living Plant. *The Journal of the American Chemical Society*, v. 47, No. 6, p. 1751-1774. Washington, D. C., 1925.

The object of this long experimental research was to see if it were possible to isolate from the living cotton plant certain odorous constituents which had an attractive effect on the stalk weevil.

From the concentrated sap of the plant, extracted with ether and distilled, a brown-yellow, clear, limpid, essential oil was obtained, of a density of 0.9261 and polarisation 3°.91, with a rather pleasing and

persistent strong odour; containing aldehyde and giving a strong reaction with furfurol.

The concentrated distillate, which represents all the odorous and volatile constituents, contains :—

(1) Methyl alcohol in large quantities and traces of acetone.
(2) Amyl alcohol in small quantities and higher homologues.
(3) Acetaldehyde and a trace of aldehyde with a higher carbon content, probably a new compound.
(4) Very small quantities of vanillin.
(5) A phenol, in minute quantity.
(6) A dicyclic terpene optically inactive.
(7) A very small quantity of one of the paraffins.
(8) A blue oil, which probably contains azulen.
(9) Formic, acetic, caproic acids.
10) Ammonia.
11) Trimethylamine.

The last two substances are found in rather considerable quantities, but ammonia predominates. Both emanate from the living plant. It seems that the trimethylamine possesses a certain power of attraction for the stalk weevil. Experiments, however, are being made to determine if it really can constitute a food for this insect. A. F.

614. **Relations between the successive quantities of phosphoric acid and nitrogen in the leaves of well manured vines.**

LAGATU, H. and MAUME, L. Relation linéaire entre les quantités successives d'acide phosphorique et d'azote contenues dans la feuille de la vigne bien alimentée. *C. R. de l'Académie des sciences*, v. 180, No. 15, p. 1179-1181, fig. 1. Paris, 1925.

The experiments of the writers show that, in well manured plants, the evolution of the physiological relations of the fertilized elements, observed in the leaf, appears to obey certain simple laws. In fact expressing the results of the observations graphically by the method of Cartesian coordinates, a line is obtained which is very nearly straight.

In May only was there a slight relative excess of nitrogen, due to the fact that the nitric part of the manure, combined with nitrogen nitrified by a favourable season, exaggerated the absorption of nitrogen, which might have been injurious to the plant. Between June and September equilibrium was attained and after the grapes were picked the leaves rejuvenated chemically and became green in comparison with those of the unmanured plot.

The reduction of the crop in the other plots went *pari passu* with the deviation from the straight line. The researches may therefore serve to demonstrate in the case of deficient nourishment and scanty yield, the insufficiency or the excess of one of the fertilizing elements in comparison with the other. A. F.

615. **A new substance in essence of lemon.**

ROMEO, G. (Chemical Lab. of the Chamber of Commerce of Messina). Sopra una sostanza presumibilmente nuova dell'essenza di limone. *Annali di chimica applicata*, v. 15, No. 7, p. 305-309. Rome, 1925.

The writer, from some kilogrammes of oil of turpentine essence, has obtained a light crystalline substance, which at sight is different from common stearoptene and which was not identified with any other known substance in essence of lemon. It melts, in the raw state at 57°-58°, is soluble in cold water to the extent of about 1 %, at boiling point 7 %, is very soluble in methyl and ethyl alcohols or, better, in sulphuric ether. Heated to an anhydrous condition, it boils at 260°, but undergoes a partial decomposition. It is dextrorotatory with a specific rotatory power of 39°.26. Its chemical formula would be $C_{10} H_{18}, O_3$; the quantity was too small to enable the constitution formula to be established. A. E.

CROPS IN THE TEMPERATE AND TROPICAL COUNTRIES

Cereals and forage crops.

616 **Recent researches on wheat in Russia.**

I. — VAVILOV, Prof. N. K. poznaniou miagkikh pchenitz *Triticum vulgare* Vill. Sistematiko-geografitcgeski etud. *Troudy po prikladnoi botanike i selekzii* Izdanie Gosoudarstvennago Instituta Opytnof Agronomii Tom 13ⁱ Vypousk 1ⁱ stran. 149-257 ; ris. 1, tabl. 3, Karta 1 (Contribution to the classification of soft wheats. *Triticum vulgare* Vill. *Bulletin of Applied Botany and Selection*, Publication of the Government Institute of Experimental Agronomy. Vol. 13th 1st number, p. 149-257, 1 Fig., 3 tabl. 1 map, summary in English, Petrograd, 1923).

II. — BAROULINA, Mme E. Opyt sistematitche skago izoutchenia rassovago sostava v upredielakh odnoï raznovidnosti miagkoi pchenitzy (*Triticum vulgare* var. *ferrugineum* Al. *Tam-je* str. 260-368, 4 kart, 7 riss., 14 tabl., bibliografia. (Experiments of a botanical investigation of characters (Jordan) in the limits of a single variety of soft wheat. *Triticum vulgare*, var. *ferrugineum* Al. *Ibidem*, p. 260-366, 4 plates, 7 fig., 14 tabl., bibliography, summary in English).

III. — ORLOV, A. Geografitcheskii zentr proiskhojderia i raivn vozdelyvania tverdoi pchenitzy. *Triticum durum* Desf. *Tam-je*, str 369-459, 12 tabl, bibliogr. (Geographical centre of origin and cultivation of the hard wheats. *Triticum durum* Desf. *Ibidem* p. 369-459, 12 tabl., bibliography, summary in English).

IV. — NICOLAEVA, M. A. Cytologitcheskoe izsledovanie roda *Triticum* *Tam-je* str. 33-44, 1 riss. (Cytological investigation of the genus *Triticum*. *Ibidem*, p. 33-44, 1 fig. summary in English).

V. — PISSAREV, V. Pererojdenie pchenitzy *Tam-je*, str. 59-70. (The degeneraton of wheat. *Ibidem*, p. 59-70, summary in French).

VI. — GOVOROV, L. Priroda razlitchii ozimykh i iarovykh form khlebnykh zlakov v sviazi s voprossom zimostofkosti ozinykh. *Tam-je*, str. 525-559, 14 tab., bibl. (The difference of characters in the winter and spring forms of cereals in relation to the resistance of winter crops. *Ibidem*, p. 525-559, 14 tabl., bibliography, summary in English).

VII. — IAKONCHKINE, Prof. S. Pchenitzy Kryma. *Tam-je*, str. 71-147, 37 tabl. (Wheat of the Crimea, *Ibidem*, p. 71-147, 37 tabl., summary in English).

VIII — ZHUKOVSKY, Prof. P. Persidskaja pchenitza v Zakavkazie. *Tam-je*, str. 45-55, 2 Kart, 7 riss. (Persian wheat (*Triticum persicum*) in the Transcaucasus. *Ibidem*, p. 45-55, 2 pl., 7 fig. summary in English).

IX. — MAKSIMOV, S. Ozimaja pchenitza Rostov. Nakhitchevanskof Opytnoi Selsko Khoziastvennoi stanzii kak sortovodnyi material *Izvestia po Opytnomou Delou Dona i Severnago Kavkaza*. Troudy Selsko-Khoziastvennykh Opytnykh Outchrejdenii. Vypousk 4ii str. 150-163, Rostoffna Donou, 1924. (Winter wheat of the experimental station of Rostoff on Don, as selection material. *Journal of Experimental Agronomy of the region of the Don and the northern Caucasus*, 4th Number, p. 150-163, summary in English, Rostoff on Don, 1924).

X. — NOSSATOVSKY, A. Polskaja pchenitza (*Triticum polonicum*) v Douskom okrouge. *Tam-je*, str. 130-135, 1 riss. (*Triticum polonicum* in the Region of the Don. *Ibidem*, p. 130-135, 1 fig., summary in English). . of

XI. — KOLMAKOV, S. Tchernooskaja ozimaja pchenitzade *riticum vulgare* var. *nigroaristatum*). *Tam-je*, Vypousk 6^{ii} str. 135-141 (*Triticum vulgare* var. *nigroaristatum*, *Ibidem* 6th number, summary in English).

XII. — TERNOVSKY, M. Pchenitza Stavropolskof Goubernii. *Troudy po prikladnof botanike i selekzii*. Gossoudarstvennyi Institut Opytnof Agronomii, Tom 13, Vypousk 1, str. 484-508, 15 tabl. Petrograd 1923 (Wheats of the Province of Stavropol. *Bulletin of Applied Botany and Selection*, publication of the Government Institute of Experimental Agronomy, vol. 13, 1st number, p. 481-508, 15 tabl., summary in English, Petrograd, 1923).

XIII. — POPOVA, Mme. G. Vidy Aegilope i ikh massovaja hybridisazia s pchenitzei v Turquestane. *Tam-je*, str. 461-482. (Species of Aegilops and their mass hybridization with wheat in Turkestan. *Ibidem*, p. 461-482, 1 plate, 3 tabl., summary in English).

XIV. — DROSDOV, N. Dikaja i kulturnaja odnozernianka v Krymou. *Tam-je*, str. 515-524, bibliogr. (*Triticum monococcum cereale* Asch in the Crimea. *Ibidem* p. 515-524, bibliography, summary in English).

XV. — FLACHSBERGER, C. *Aegilops triuncialis* L. *nigriaristata*. *Tam-je* str. 483-484. (*Aegilops triuncialis nigriaristata*. *Ibidem*, p. 483-484, summary in English.

The series of Articles here reviewed forms a sufficiently complete collection to judge the importance of the researches made in Russia of recent years.

This chief product of agricultural crops has been studied from the systematic, ecologic, genetic points of view and from that of selection, always bearing in mind the application of the result of these researches to agricultural practice.

The greater part of these researches have been suggested if not di-

rected by Professor VAVILOV of Petrograd ; he it was who gave the general direction to them, he who determined their method, he who is invoked by most of the research workers of his school, it is he and his law of homologous series in variations which they quote on each occasion. His research on the classification of soft wheats has consequently been placed first, especially as he there puts forward new ideas as to the part which the minute investigation of races and lines should play in the classification. His work also is very interesting for the light which it throws on the question of the origin of cultivated wheat, a question still insufficiently examined.

I. — The investigation of a large number of varieties of wheat, from the point of view of their resistance to parasitic diseases, has led Prof. VAVILOV to the conclusion that soft wheats have a great diversity of form easily discernible by their physiological and morphological peculiarities ; the botanical lists which only distinguish 22 *Körnicke* or 26 *Flachsberger* varieties give but a small idea of the diversity of the forms which are met with in cultivation and which closer investigation easily brings to light. The writer has collected during his travels in Persia, Bokhara, in Turkestan and the Pamirs, a great number of specimens of soft wheats which were the object of six years research by the writer and his collaborators. Among these specimens he discovered many new forms, which clearly shows the insufficiency of the existing classification.

In his present paper he has tried to correlate the diversity of the characters of varieties with those of other species of cereals on the basis of the law of homologous series in variation (1).

He also attempts to elucidate as much as possible the question of a certain fundamental regularity in the geographical distribution of the various varieties, and to discover the centre and diversity of their origin — a question which has not yet been thoroughly dealt with by investigators.

In the present classification of varieties of soft wheat the principal character is the presence or absence of awns. Now, the writer records that there is in Asia a whole series of spring and winter wheats which have an intermediate character between the bearded and the beardless wheats. These forms indeed have awns, but they are fewer and much shorter than in bearded wheats and the lower portion of the ear is always unprovided with them. The ordinary length of awns in bearded wheats is from 6 to 7 cm., while in the intermediate forms their length varies from 2 to 4 cm.

From the writer's experiments these intermediate forms are easily obtained by crossing *Triticum vulgare lutescens* with *Tr. dicoccum picnurum* ; the semi-aristate forms appear in the second generation and this character continues hereditary and constant in subsequent generations.

The writer considers that, by analogy with the classification of *T. dicoccum* and of barley, this semi-aristate character should be adopted for distinguishing new varieties, for the naming of which the writer proposes the addition of the preposition "*sub*" to the latin name of the corresponding bearded variety. He thus distinguishes the new varieties *sub-ferrugi-*

(1) VAVILOV, N. The Law of Homologous Series in Variation. *Journal of Genetics*, 1922.

neum, *sub-graecum*, etc. Well known in the classification of barley is the group of varieties which are either unprovided with awns or have very short awns, much curved and enlarged at the base, whose glumes bear an appendix of three lobes forming a rudimentary spikelet (hooded type); to this group belong the varieties *trifurcatum*, *Horsfordianum* and *laxum*. Now, the writer has found a series of similar mutations in certain varieties of wheat of Chinese and Persian origin. Their glumes have not completely lost their awns but the latter are short, curved and enlarged at their base, while the glume is extraordinarily swollen; this latter character has caused them to be placed in a separate group, including several botanical races, which has been named *inflatum*.

The writer considers that the analogy of these morphological characters of wheat with those of barley is very evident. To make certain of the fact, from a genetic point of view, he has crossed these forms of wheat with bearded and beardless varieties; on repeating the operation he has obtained on the one hand distinctly bearded forms and on the other forms almost devoid of awns, which shows that here is certainly a similar phenomenon to that of the *trifurcatum* type in barley.

The specific character of this mark, the peculiarity of its genetic nature, the ease of its distinction and the analogy with a similar mutation in barley, enables this character to be adopted to distinguish the whole group of *inflatum* varieties, by associating with it other similar varieties which the writer names, for example *albinflatum*, *rufinflatum*, *alborubrinflatum*, all having the same character.

Figure No. 126 represents the characteristic types of aristate glumes of varieties of the *inflatum* group opposite those of barley of the *furcatum* group.

It follows from these facts ascertained regarding the semi-aristate wheats and those of the *inflatum* group, that there is full analogy between the cycle of variations in the forms of barley and that of wheat. Indeed, the writer distinguishes the following forms for these two cereals:—

For barley	For soft wheat.
Beardless (*inerme*, *subinerme*, *tonsum*)	Beardless (*muticum*)
Aristate (*aristatum*)	Aristate (*aristatum*)
With short beard (*Brachyaterum*)	Semiaristate (*brevi aristatum*)
Trifurcatum	*Inflatum*.

The insufficiency of the present classification of varieties of wheat is clearly shown by the fact that the same variety of ten includes many forms which differ from each other, not only by a single important character, which would suffice for considering them as distinct varieties, but sometimes even by 20 characters.

The present classification of varieties of soft wheat is entirely and exclusively based on the differences of the ear. Now, the writer has found among the various speciments of soft wheat of Afghanistan a series of forms which, while distinguished from one another by more or less important characters, have one character common to all, namely that of

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complete absence of ligules and auricles at the place where the leaf blade is attached to its sheath. These forms comprising several varieties constitute, in his opinion, a separate group, similar to the semi-aristate group and the *inflatum* group referred to above. This group of wheat without ligules has a well determined geographical habitat, the centre of which is Afghanistan.

The experiments of crossing made by the writer have enabled him to

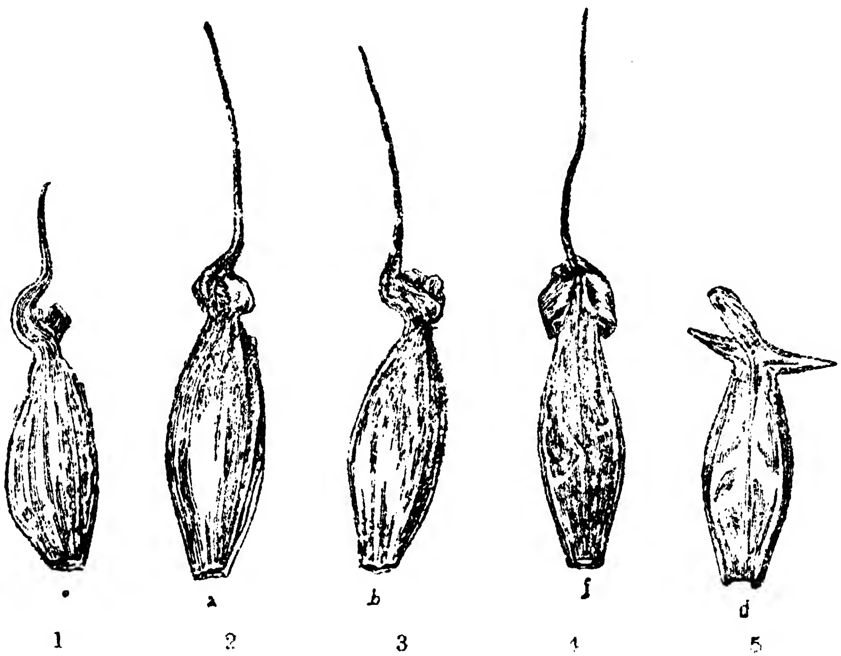

FIG. 126. — Characters of glumes of inflatum group of soft wheats of Persia (1, 2, 3). — Characters of the glumes of "hooded" barley.

verify that the absence of the ligule was indeed, as he expected, a dominant character. Segregation is produced in the second generation, in the proportion of 20 forms provided with ligules to one devoid of them, and that proportion remains constant in spite of the large number of plants of the second generation which amounted to several thousands of individuals.

The writer has also ascertained, as indeed he expected, by reason of the law of homologous series in variations, that the same character — absence of ligules — was also found in plants of oats, rye and maize in the same region, and he thinks that further investigations will lead to its discovery in yet other cereals.

Now, the adoption of the three characters indicated, forming three

new groups of varieties — *breviaristatum, inflatum* and *eligulatum* — already enables 67 varieties of the species *Triticum vulgare* Vill. to be distiinguished, which only had 26 varieties according to the present classifications of KÖRNICKE and FLAKSBERGER. The writer gives the scheme of this new classification, which cannot be reproduced here owing to want of space.

However, in the writer's opinion, these results are not yet satisfactory in spite of the increased number of varieties thus obtained. Indeed, it has already been seen that several varieties include numerous forms which are distinguished from each other by many important characters. It could not, indeed, be otherwise, the variety being itself a conventional unit insufficiently determined and including a conglomeration of races, often presenting very marked differences one from another. The writer considers that it is only this last division, the race, which is a perfectly definite concept really existing in nature. We know that, according to YORDAN and DE VRIEES, a race of autogamous plants is the smallest grouping unit including all individuals with the same morphological and physiological characters which it possesses by reason of heredity, being at the same time all bound up together by their common origin. To establish throughly the characters of a race of autogamous plants, it is necessary to operate with perfectly pure lines and to verify the heredity of distinctive characters in several generations. It is true the race may include in its turn several genetic types and that consequently certain forms of the same race may differ from one another by certain hereditary factors.

The determination of genetic types depends on the accuracy of the detailed hybridological analysis, and it is evidently still impossible for the moment to establish in a certain and complete manner all the hereditary characters which might serve to determine all races of one species or even of a single of its varieties.

The writer has undertaken this work for the races of soft wheat, especially its Asiatic forms, and although he considers his research still incomplete, he has nevertheless already established 66 fundamental characters for the distinction of races, and these characters admitting of further subdivision, their total number reaches 166, all easily recognized, hereditary, constant and independent of local conditions. The schedule of these 166 characters is not reproduced here and only the four groups distinguished by the writer are indicated. To form these groups the writer has taken first of all the complexity of characters which are proper to a grouping of races and which are ordinarily accompanied by a series of other characters united with them by a bond of correlation, while always remaining independent of the influence of their surroundings. What is moreover important to remember is that these complex characters apply also to geographical grouping of races which they denote.

Among these group characters the writer mentions one, by way of example, which is only rather rarely met with in soft wheats — namely the existence of a soft medulla in the upper part of the culm which gives the latter greater strength than usual; the small group of races with this medulla is found in Persia and in Palestine; their distinctive peculi-

arity is generally accompanied by other peculiarities in the structure of the ear and by greater power of resistance to parasitic diseases.

Another character common to a whole group of races is the firm adherence of the grain to the glume, the roughness of the ear and the awns; the forms which have these three characters are xerophytes and belong to the South-West of Asia, while a group of races with smooth awns and which readily drop their grain is more or less localized in the temperate regions of Asia and Europe. The second group of characters is of a mainly qualitative nature; these characters are at the same time quite distinct, independent of conditions of environment and constant in certain well determined races. Such, for example, are the pubescence of leaves, the aspect of young plants, the length of the appendices of sterile glumes, the form of the grain and others.

The writer places in a third group the quantitative characters easily recognized, but fluctuating, which may be determined by comparison between various races grown under the same conditions. Such are the length of the ear and of the awns, that of the stalk, the length and breadth of the leaves, the duration of the growing period, etc. These characters have often great importance from the standpoint of practical agriculture.

To the fourth group belong very fluctuating qualitative characters which, consequently can only be used very cautiously. Although always sufficiently forming the peculiarity of separate races, these characters can only be clearly determined by comparison with other races grown under the same conditions during a series of several years. Such are tillering strength, the consistency of the grain, the yield. In the main, the characters of this group are only distinguished from those of the preceding group by their greater fluctuation and the difficulty of their application for the determination of race.

The writer gives a schedule of characters of different races distributed among these four groups, but this schedule does not include more than 36 characteristics instead of the 66 characters with their 166 subdivisions. The simple reason for this is that these characters are here found collected in complex groupings so as to completely characterize each race.

The writer naturally admits the possibility of a different grouping. Only, he draws attention to the fact that, in order to have a solid basis, the characters of a race should have two principal qualities — constancy and independence of environment. From this point of view he does not approve of the predominant method of basing the characteristics of races on the factors which have great importance from an agricultural standpoint. In fact, these characters are generally very variable, dependent on climate, on qualities of the soil and other local conditions, and are therefore of little use from a botanical point of view. This does not prevent him admitting that sometimes the local conditions may prevail over the power of heredity and determine mutations in the principal characters of a botanically well established race.

The number of races of soft wheat reaches, according to the writer, a figure of several thousands, and most of these races have not yet been

sufficiently studied for it to be possible to give an exact and detailed description of them.

In spite of this enormous diversity, these numerous races may be divided, according to the writer, into three great groups to which he gives the names :— (1) *Indo-European* or *Arian Indo-European* ; (2) *rigidum* with stiff ears; (3) *speltiform*. Each of these groups forms a genetic section and its habitat is well determined. The first predominantes in Europe and Siberia, but it is also found again in isolated mountainous regions of the South-West of Asia.

The *rigidum* group is well localized in the South-West of Asia, in Turkestan, Persia, and Bokhara, but it is also found in Europe and in the North of Asia.

The *speltiform* group belongs more particularly to the South-West of Asia, where it is often grown without irrigation.

In the latter part of his paper the writer deals with the problem of the origin of soft wheats. It is known that, according to the ancient theories, wheat in general had its origin in the regions situated between the Tigris and the Euphrates and afterwards the Caucasus, Persia, and the coast of the Caspian were added to these regions. The writer thinks that it is impossible to solve a problem essentially so complex and that the countries of origin of varieties and races should first of all be discovered. In order to solve this problem according to the method of botanical geography, the habitat of various varieties of a given species must first be determined and in that region must be found the centre of the divergencies which are produced in the greatest number of forms belonging to that variety. According to his investigations, the countries which in spite of all international exchanges, have still preserved the greatest number of endemic forms are precisely the regions of South-West Asia, Persia, Afghanistan, Bokhara, Beluchistan, India, Turkestan and Khiva. He has recorded for these countries the following numbers of varieties of soft wheat :—

Persia 52.
Afghanistan, Bokhara, Beluchistan, 46.
India, 32.
Turkestan and Khiva, 32.

The concentration of a great diversity of forms of soft wheat in the South-West of Asia is still more clearly borne out if not only the varieties but also the botanical characters of the different races are considered. The whole of the 66 characters and their 166 subdivisions established by the writer are found in these countries.

The principal centre of all the diversities of races of soft wheats is therefore the South-West of Asia, and it is certainly that region which must be the country of origin of soft wheat. It is therefore in that country which produces, owing to its mountainous regions separated by vast plains, almost all forms of spring and winter soft wheat under the most varied climatic conditions, that the selector should seek for the forms which suit

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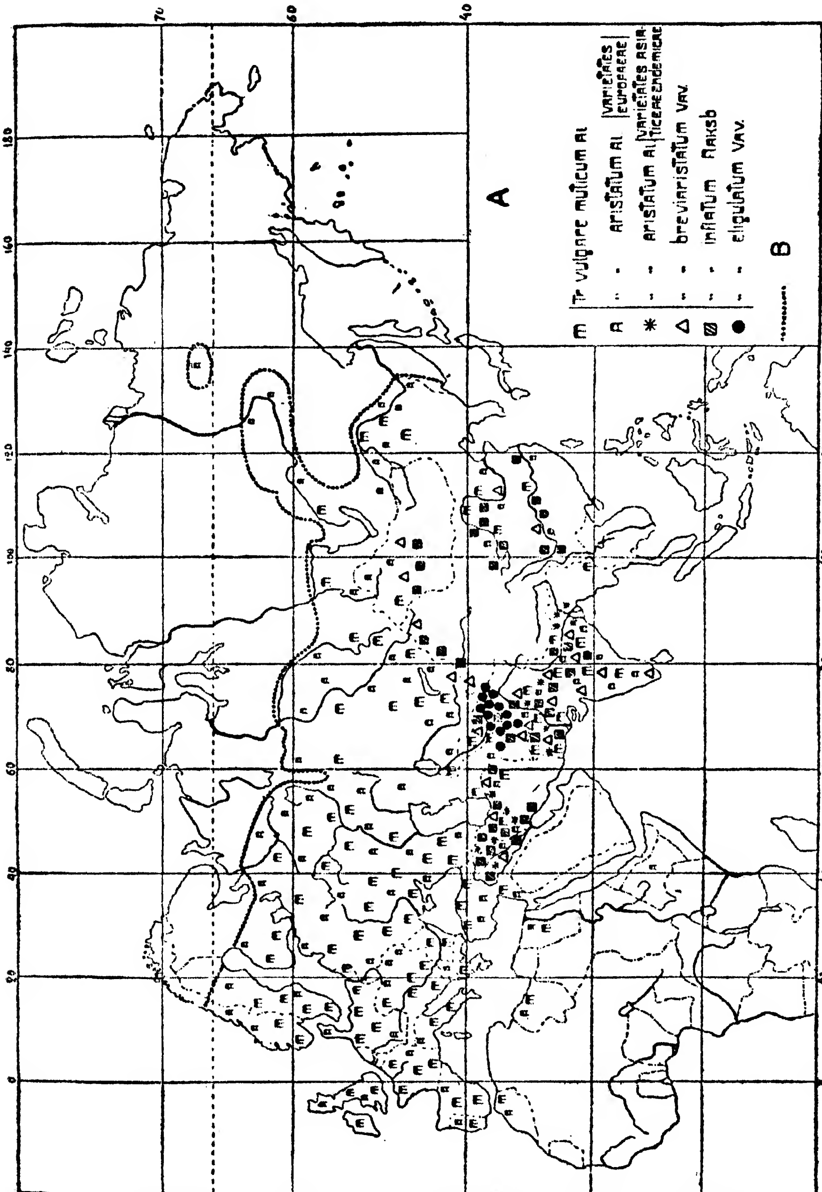

FIG. 127. — Geographical distribution of Botanical varieties of soft wheats in the old world.

him best, whether for direct acclimatization or for crossing and the production of improved races.

II. — The paper by Mme BAROULINA is the result of the application of the principles set out by Prof. VAVILOV regarding the importance of the thorough study of races.

The writer has in view the detailed study of the systematic characters of all forms composing the smallest genetic units (isoreagents according to RAUNKIDER, Iordaneus according to LOTSY) within the limits of a single variety of soft wheat. She has chosen with this object a variety which has many forms and which is very common in regions with the most diverse climates from the South-West of Asia right up to the northern limits of the growth of wheat, sometimes as winter wheat, sometimes on land sown in spring. The variety *ferrugineum* satisfies all these postulates and has the further advantage of having been little modified by selection and of being useful everywhere to determine not only the characters of the variety but even those of the whole species.

The writer has operated on 197 samples coming from all parts of the world, obtaining very pure lines for determining the characters sought for. Her research which has lasted for five years has revealed the existence of an enormous quantity of distinct races and characters within the limits of that single *ferrugineum* variety. Out of 98 specimens of spring wheat the writer has been able to determine 33 races, while 40 forms of winter wheat belonged to 9 different races. Altogether, the writer has found 50 distinct characters which she has divided into 4 groups; these are the characters :— (1) of the ear, (2) of the grain, (3) vegetative and (4) biological.

We shall not follow the writer into the detail of the enumeration of these characters, nor into the schedule of their grouping to form the 42 races which she has determined. It is needless to add that the disciple here follows the arrangement adopted by the master — Prof. VAVILOV — and distributes the 42 races among the 3 groups, *Indo-European*, *rigidum* and *speltiform* mentioned above. The polymorphism of Central Asian wheats is greater than that of European wheats and that of wheats from the temperate regions of Asia. The *rigidum* and *speltiform* groups coming from Central Asia contain the greatest number of forms; out of 14 specimens of the *speltiform* group the writer has recorded 7 races, while she has found 5 races in 9 specimens of *rigidum* and 20 among a hundred specimens of the *Indo-European* group. In this last group the writer distinguishes two further subdivisions :— the Siberian sub-group and that of the Pamirs. This division by groups is, moreover, further applicable to other varieties of soft wheat. The detailed examination of various varieties has shown that all race characters are repeated with great uniformity in all varieties of *Triticum vulgare* and that the direction of variability in these characters is identical.

The four plates here given (Fig. 128-131) show the appearance of the ears, the spikelets of the grains and glumes of four typical races of the *ferrugineum* variety of which one belongs to the *rigidum* group, two to the Indo-European group and the fourth to the *speltiform* group.

PLATE XXXIX

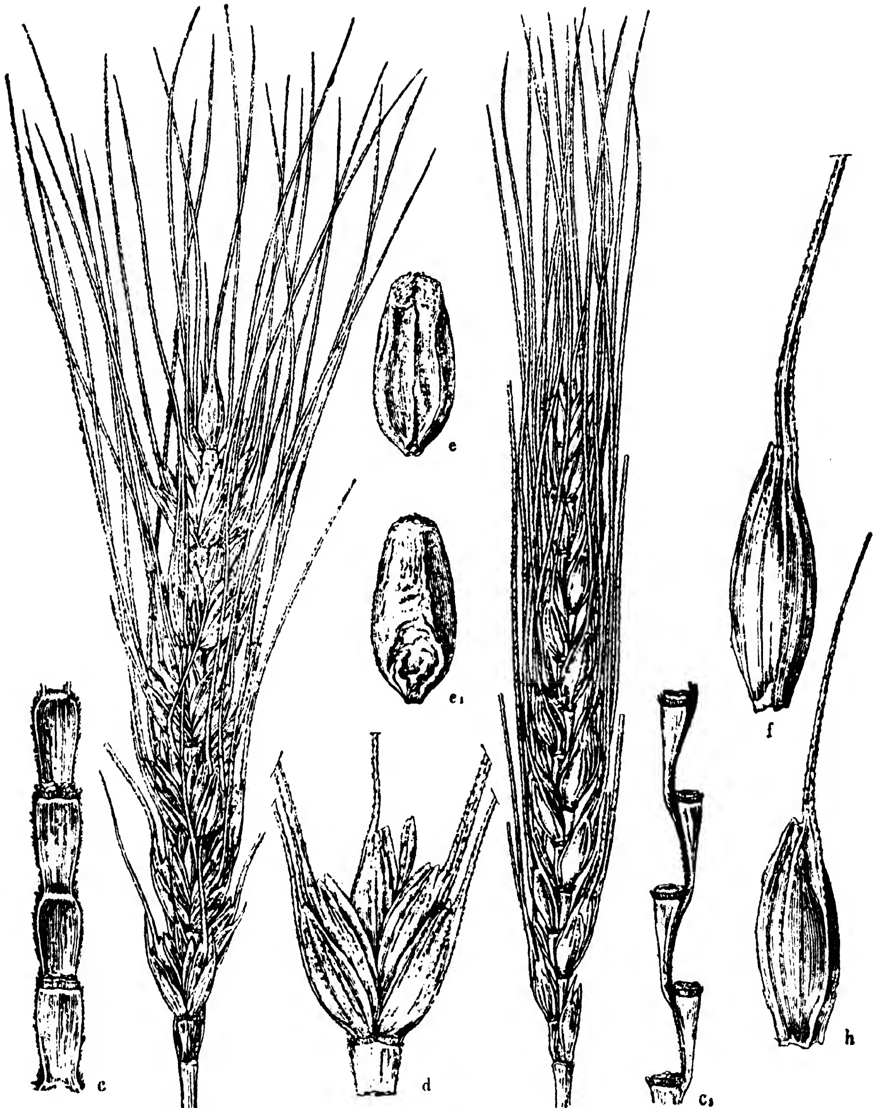

FIG. 128. — *Triticum vulgare* var. *ferrugineum*, *rigidum* group, race of the Bokhara mountains, spring wheat.

PLATE XI.

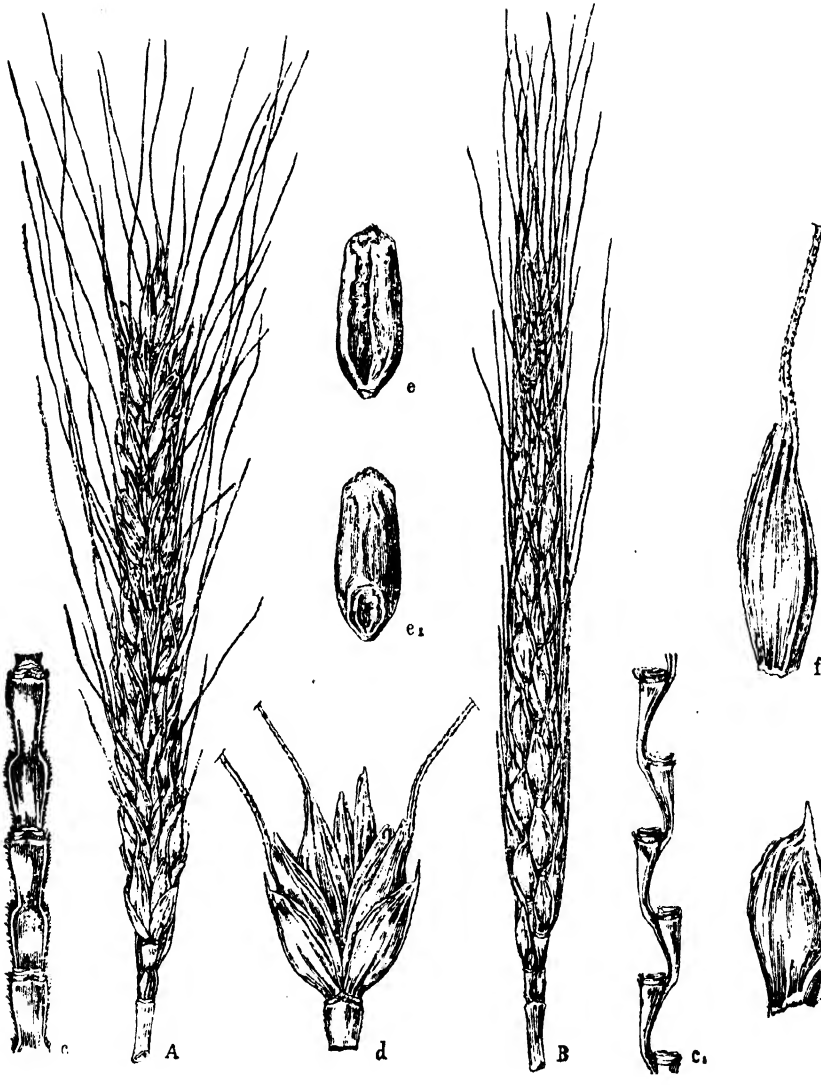

FIG 129. — *Triticum vulgare* var. *ferrugineum*, *Indo-European* group, race of the Pamirs and of Shougnan, spring wheat.

PLATE XLI

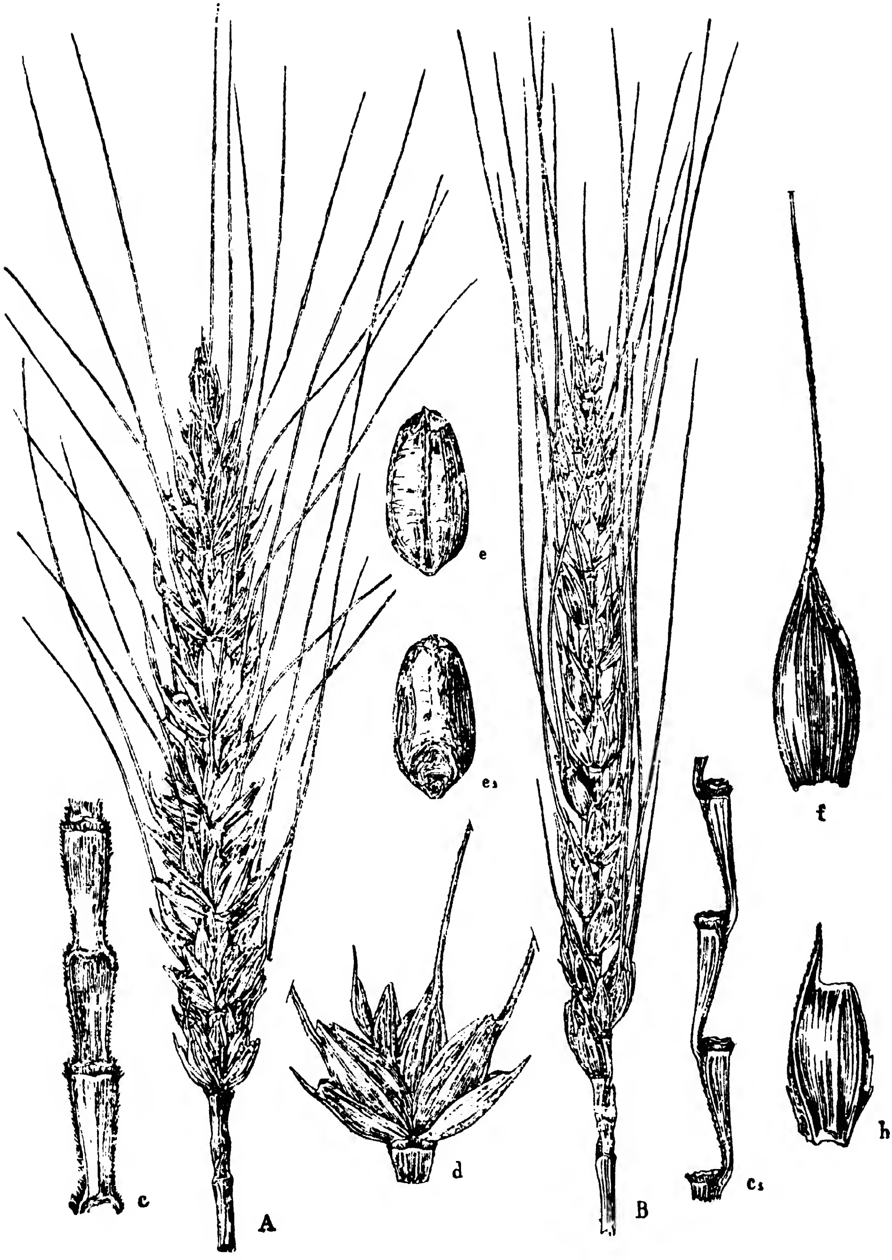

FIG. 130. — *Triticum vulgare* var. *ferrugineum*, *Indo-European* group, Breslau race, spring wheat.

Plate XLII

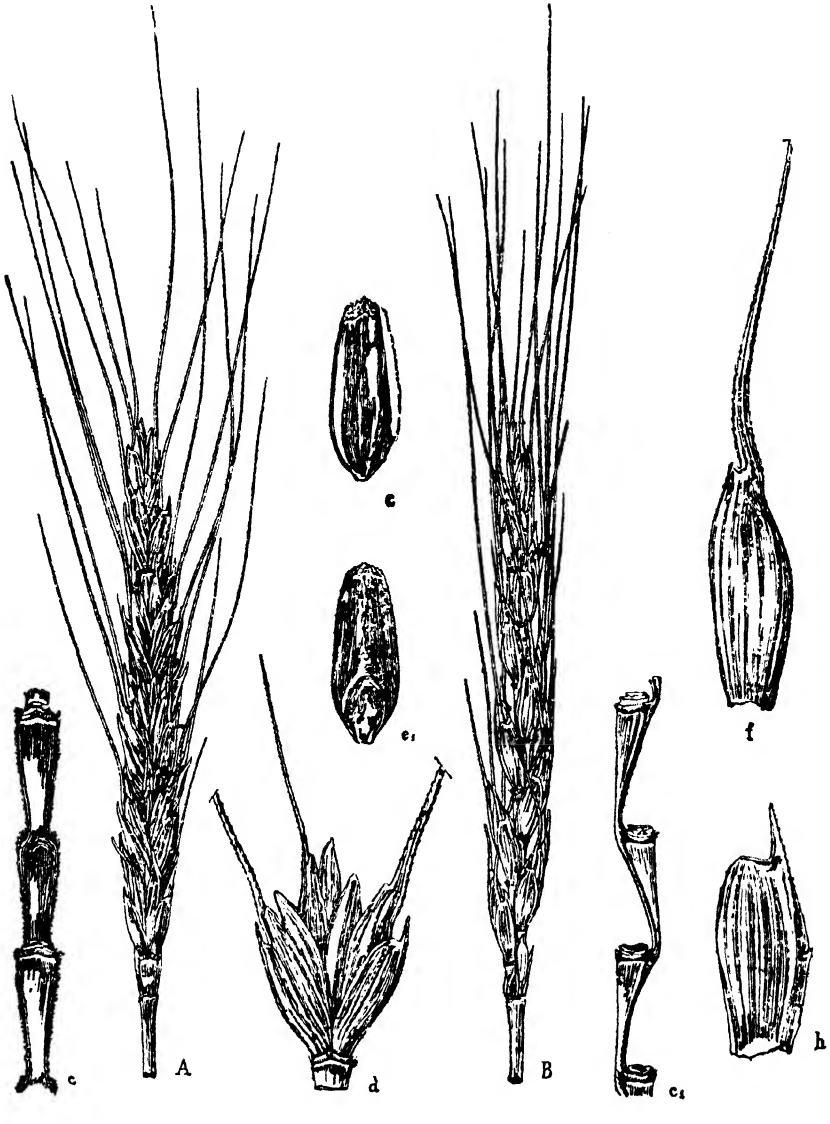

Fig. 131. — *Triticum vulgare* var. *ferrugineum*, *speltiform* group, race of the Bokhara mountains, spring wheat.

III. — Prof. ORLOV has attempted a research on hard wheat similar to that of Prof. VAVILOV on soft wheat, in order to determine its origin.

The country of origin of hard wheat had not previously been determined. The writer has managed to study a great number of specimens of this wheat and thereby solve this problem. Using the geographical-botanical method, he has determined the geographical distribution of the various botanical forms of this species, and he has then sought out the regions of concentration of his varieties and races, which are the places where the polymorphism of the species is apparent in its greatest intensity and where the greatest quantity of endemic forms are found.

He first records the principal groups of varieties of *Triticum durum*, which are :— 1st the aristate group (*aristatum*) including the most ordinary forms of bearded hard wheat , whose cultivation is very wide spread throughout the world ;

2nd the beardless group (*muticum*) ; these forms have been obtained artificially by crossing ordinary forms of *T. durum* with other species. Consequently this second group is of no use for investigating the country of origin of the species.

The first group is subdivided into two sub-groups which are :—

1st *Aristatum commune*, with high culms, elongated ears, length 6 to 11 times that of breadth.

2nd *Aristatum duro-compactum*, dwarf forms of hard wheat ; the culm is short, the ear very compact, its length does not exceed 4 to 5 times its breadth or thickness.

According to complex hereditary characters, the writer further distinguishes two types of *aristatum commune* :— the *oblongum* type, in which the ear, the glumes and the grains have an elongated form ; the *compactum* type, with short compact ears, with sterile oval glumes, with bulky short grain.

The growth of aristate hard wheat is extremely widespread in Western Europe, Russia, India, Persia, North America, and Australia. Nevertheless, of all parts of the world, Africa stands first for the number of varieties of hard wheat found. That continent, in fact, produces all varieties of *Triticum durum* which have hitherto been described. A large quantity of endemic forms, peculiar to it, are also found there. On the other hand, only 20 varieties of hard wheat are found in Europe, 18 in Asia and 6 in Australia, and no variety has been discovered in these continents which is not also found in Africa.

This distribution of varieties enables Africa to be considered as the original mother-country of the various types of *durum*. Now, the same tokens being recognized in a more detailed investigation of the distribution of hard wheat in Africa, permits the conclusion that its centre of origin is in the North of this continent. Abyssinia, Egypt and Algeria are particularly remarkable for the diversity and abundance of forms which they contain.

In Europe, hard wheat shows a fairly large number of forms in Spain and Italy, in Russia — in the basin of the Don and beyond the Volga and in the Caucasus — in Georgia. Up to the beginning of the XX century it

was Russia which principally supplied the international market with hard wheats, but since then this species has started being grown in large quantities nearly everywhere, especially in America, and even in Australia.

The most widespread varieties are :— *T. durum hordeiforme, coerulescens* and *melanopus* which include also the greatest number of races. *Durum* is pre-eminently a wheat of the steppes ; it is mainly sown as a spring crop. The commercial kinds which give the most abundant yields are :— (1) *Acme,* (2) *Arnautka,* (3) *Monad,* (4) *Buferd,* (5) *Kukauka,* (6) *Trigomocho,* (7) *Medeah,* (8) *Péllissier,* (9) *Arnautka No.* 10 and (10) *hordeiforme Host.*

IV. — Mme. NIKOLAEVA has attempted to apply the cytological method to the botanical classification of the different species and varieties of the genus *Triticum.*

It is known that this genus numbers more than 2000 different races among cultivated plants. Hitherto, three methods were used for establishing genetic distinctions between these numerous kinds, namely :— the study of hybridization and of its products, the serological method and observations on resistance to plant pests which is known as the immunity method. By these three methods 8 species of wheat have been distinguished, which according to the affinity existing between them, were divided into three groups. These species are : *Triticum vulgare* Vill., *Compactum* Host., *Spelta* L., *durum* Desp., *turgidum* L., *dicoccum* Schvank, *polonicum* L. and *monococcum* L. The first three form the first group of which the prototype is soft wheat ; the 4 following species form the group of hard wheats, while *monococcum,* not being able to be placed in either of these groups forms a separate group by itself.

Now the author considered that possibly the structure of the cells would give sufficient factors and new indications for genetic classification. She began by investigating the cells of oats, which present greater facilities, and she deduced therefrom that a certain relationship undoubtedly existed between the number of chromosomes in the cell and the other indices of genetic affinity. An equal number of chromosomes is not necessarily an index of relationship between plants, but an unequal number surely points to the impossibility of crossing, or at least sterility of the hybrids. Mme. NIKOLAEVA carried out her researches on young plantules, which she obtained by the germination of seeds on filter paper. For wheat plantules, this investigation was peculiarly difficult because of the great number of chromosomes and of the peculiar form of the filaments which form a very long system folded over and mixed up in a very complicated manner.

In spite of these difficulties, the writer has suceeded in proving that the number of chromosomes was actually different in the wheats of the three groups mentioned above, while it was equal or approximately equal in species belonging to the same group. As a matter of fact, the writer has ascertained that the first group of soft wheats was characterized by 42-44 chromosomes ; this number was found in the species :— *T. vulgare, spelta* and *compactum.* The metaphases of this latter species however showed sometimes 42-44 and even 50 chromosomes. The writer draws from this

the conclusion that this species may, perhaps, be composite and contain different forms.

The second group invariably contains 28 chromosomes, this number being ascertained in *T. durum, turgidum, polonicum, dicoccum, orientale* and *persicum.*

Lastly, the species *T. monococcum* is distinguished from all the other

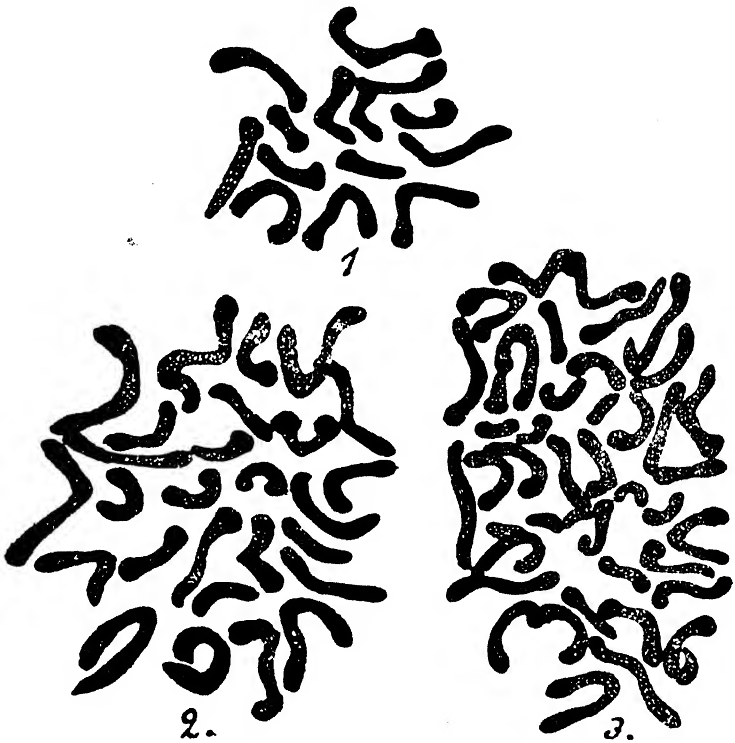

FIG. 132. — (Bulletin of Applied Botany p. 43). Chromosomes in the 3 groups of wheats:—

1. *Triticum monococcum* L. 14 Chromosomes
2. *Triticum durum* Desf. 28 "
3. *Triticum vulgare* Vill. 44-42 "

by having only 14 chromosomes; it should, therefore, form a separate group by itself.

Fig. No. 132 shows the arrangement of chromosomes in the three groups of wheat above mentioned :—

It is therefore important to note the complete parallelism between the results of cytological analysis and those which are obtained by the three other different methods: the hybridological method, the serological

method and the method of immunity give the same grouping of the genus *Triticum*.

V. — Working in the region of the province of Irkutsk in Eastern Siberia, where the climate is particularly hard, M. PISSAREV determined to study closely the phenomenon well known in these regions of the degeneration of wheat introduced from regions with a milder climate and especially from Western Siberia. He began by ascertaining the fact that ordinarily the imported seed contained grains belonging to several botanical varieties, sufficiently near each other however, to form a more or less uniform type of wheat. He chose one of the most common of these types in the seed trade in Siberia which is there known under the name of "*bielokoloska*" (white ear) in distinction to "*kraznokoloska*" (red ear) which has been acclimatized longer to the country. Having taken a sample of seed of imported "*bielokoloska*" he grew it for five years in experimental plots, under conditions as similar as possible to those of ordinary cultivation in open fields.

These experiments resulted at the end of the fifth year, as might have been expected from observations of practical cultivation, in the almost complete transformation of the *bielokoloska* sample into wheat of the *kraznokoloska* type, more suited to the climatic conditions, especially owing to its more rapid ripening and its shorter growing period.

However, botanical analysis of the sample and of its successive derivatives of five years enabled the writer to ascertain that it was not a case of real "degeneration" but simply of the progressive disappearance, at each fresh harvest, of certain botanical varieties composing the sample, while other varieties, more suited to the climatic conditions, multiplied at the expense of the eliminated varieties. The more resistant varieties thus managed to predominate very quickly in the composition of the mixture and completely changed the general aspect of the type grown.

The results of these botanical analyses to determine the composition of the mixture are reproducéd in the table below which shows clearly the progress of the process of transformation.

TABLE I. — *Percentage of botanical varieties composing the mixture.*

Varieties	1913	1914	1915	1916	1917
Triticum vulgare var. *lutescens*	72.0	38.8	31.0	23.2	7.6
» » *ferrugineum*	10.9	36.5	41.0	49.4	82.4
» » *erythrospermum*	9.3	13.0	18,4	18.0	5.7
» » *milturum*	6.1	11.7	9.6	9.5	4.3
» *durum* / » *compactum*	1.7	0.0	0.0	0.0	0.0

It is seen that the variety *lutescens* which predominated in the original sample and gave it its *bielokoloska* character, since its ears are light in colour and without awns, is reduced so as to form only 7.6 % of the

mixture at the end of five years. On the other hand, the variety *ferrugineum*, with red bearded ears has become predominant and gives its character to the whole sample, wrongly termed degenerate.

VI. — Many writers have endeavoured to establish a relationship between the resistances of winter cereals and certain visible characters of these plants, such as the violet pigments of the young seedlings, the sprawling appearance of their shoots, the reduced surface of the leaves, their pubescence, the intensity of tillering and the size of the stomata. The experiments of W. GOVOROV on a large collection of varieties of winter wheats have led him to deny the existence of an intimate correlation between the resistance of the plant and its morphological or anatomic characters. At most it may be affirmed that winter wheats possess the above-mentioned characters more often than the others, but the same characters are undoubtedly met with quite as much in wheats which winter badly as in the spring forms. This conclusion might, indeed, have been foreseen in consequence of VAVILOV's law of homologous series of variability, the same variations being in fact repeated in the forms of winter wheats and in those of spring.

The correlation between the quantity of dry matter in the leaves and the resistance to frost, which had been found by SEELHORST and SIUZ, is not confirmed in the writer's experiments.

Several Russian writers had observed the fact that great resistance of winter wheats was accompanied by a great development of the first tillering node above the surface of the soil.

The difference of development of this node is well brought out if the plant is grown in the dark and at a low temperature ; the tillering node is then developed above the soil at a greater distance from the seed in wheats which winter badly, while it is nearer the seed in resistant winter wheats. Spring forms and those which stand wintering badly have this node at a greater height when the temperature is low than when it is high ; resistant wheats, on the other hand, have the node lower when the temperature is low. This shortening of the node is therefore in fairly evident relation to resistance.

The winter resistant forms are distinguished from badly resisting wheat and from spring wheat by higher osmotic pressure of the cell sap, and their leaves contain more glucose at low temperature. However the reservation should be made that the parallelism is not complete in this case between the intensity of these characters, especially of the glucose content and the various degrees of resistance of different species.

The most marked character by which winter wheats with various powers of resistance are distinguished from spring wheats is the degree of variability in the glucose content when the plant is subjected to a considerable change of temperature. A pot culture in the open air has been studied from the middle of August up to the end of September. When the temperature fell to 0°, the plants which happened to be at the tillering period were moved into a greenhouse heated to 15°. The spring wheats showed a considerable loss of glucose, while the winter wheats and even their most delicate forms, did not react at all to the change of temper-

ature. On the other hand, the winter wheats showed an increase in their glucose content when they were moved from a warm temperature to colder air.

On a par with the increase of glucose at low temperatures, a greater decrease in respiration is also noticed in the winter forms. On the contrary, when the temperature rises the spring forms begin to respire more actively than the winter wheats. These differences between winter and spring wheats are more marked at the periods of tillering and of complete growth.

Under the conditions of the Moscow climate the greatest power of resistance to wintering is recorded in the forms which are caused by cold to accumulate more glucose, decrease their respiratory activity and pass most quickly to a state of suspended animation. In this climate the plant perishes under the snow only when oxygen becomes deficient in the soil, for it is only at its expense that it can respire. Lack of oxygen in the soil is ordinarily the consequence, either of too great humidity, or of its excessive pulverization.

VII. — Prof. IAKONCHKINE's paper gives a description of types and varieties of wheat grown in the Crimea and in the province of Taurida, with indication of their geographical distribution and their ecology. The description of processes of cultivation is based on observation, on the results of inquiries and on data found in the literature on the subject. The varieties have been subjected to experimental study : with this object the writer made as complete a collection as possible of types of wheat grown in the country during his expeditions across the region, and he then grew them in experimental plots. The paper only deals superficially with spring wheat, the growth of which is declining in the Crimea. The writer, however, makes out that the abandonment of that crop is not completely justified. The conditions in the Crimea are certainly much more favourable for winter wheat than for spring wheat, which cannot and ought not to come into competition with the former. But there is no reason for not giving spring wheat preference to barley and oats. Indeed, in respect of resistance to drought, spring wheat is more advantageous than these other two cereals ; the coefficient of evaporation being 441 for the wheat (*bielotouzke* kind), while it is 440 for barley and 480 for oats. Besides, wheat is more adapted to saline soils and stands dust better than barley and oats. The coarse texture of the soil in the fields of Taurida alone constitutes a great hindrance for spring wheat, which is rather exacting and fastidious in this respect . But that coarse texture can and should be got over by cultivation, since it is solely the result of backward and insufficient cultivation.

Among the 90 samples of spring wheat investigated by the writer, the variety *lutescens* always predominated, mixed with a certain amount of the varieties *caesium, erythrospermum* and *milturum*. The hard wheats of Northern Taurida belong to the varieties *valenciae, leucomelon* and *leucurum*. As regards winter wheat, it predominates especially in the eastern regions of the peninsula, where sometimes the fields of winter wheat cover up to 80 % of the arable area. The cultural processes in

the Crimea are still very primitive and spring fallows are very extensive.

The writer's cultural experiments have dealt with 1000 samples of seeds, collected in the region. 90 % of these seeds belonged to the variety *erythrospermum* and two thirds of the samples only contained that variety without any mixture. The others were chiefly mixed with seeds of the variety *ferrugineum.*

Varieties without awns and those with white grain were rarely met with and velvety varieties were completely lacking. On the other hand varieties with black awns (*nigro-aristatum*) and with black glumes (*caesium* and *nigro-ferrugineum*) were often found ; the writer even discovered a new variety which he has named *nigro-erythrospermum.* Generally speaking Crimean winter wheat is very uniform in type. The richest soils show indeed some diversity in the botanical composition of this type, but the variety *erythrospermum* predominates almost exclusively on the poorer soils. In the Crimea the number of specimens of *Krimka* exceeded by one third that of the *Banatka* type. In Northern Taurida on the other hand the *Banatka* type predominates.

A third type of indigenous winter wheat seems to belong to the *Krimka* kind, the name of which has been forgotten. This type is not frequent and it also is composed almost exclusively of the variety *erythrospermum.*

TABLE II. — *Chief distinguishing Characteristics of "Krimka" and "Banatka"*

	Krimka	Banatka
Length of ear	9.11	10.74
Thickness of ear.	0.84	0.01
No. of full grains per ear.	17.0	17.0
Density	2.13	1.84

Determination of the absolute weight of grains of various varieties has shown that the heaviest grain (40.58 mgs.) belongs to the variety *caesium* ; the second place is held by *ferrugineum* (38.2 mgs.) : next in order followed the varieties *alborubrum* (37 mgs.) and *erythrospermum* (36.3 mgs.) The relatively considerable weight of *alborubrum* has this interest, that in the Crimea wheats without awns rarely give a good grain. To sum up, it may be said that the Crimea is pre-eminently the region of the variety *erythrospermum* and of the type *Krimka.* This type is not much favoured in the market, but it stands drought very well, which makes it an excellent material for selection with a view to the control of this scourge in regions which have an insufficient rainfall.

VIII. — Prof. ZHUKOVSKY begins by recalling that in his monograph on the "Immunity of Plants as regards Infectious Diseases" Prof. VA-

VILOV had determined a new species of wheat, according to Linnaeus, which was up to then unknown to agricultural science and which he had named *Triticum persicum* Vav. The determination was based on the indices furnished by its disease resisting capacity, by hybridological and cytological analysis and by some morphological peculiarities of the new species. As regards its name, it had been chosen from the somewhat uncertain indication of its origin given by the commercial firm which had supplied the grain.

Now, the writer, having specially studied the wheats grown in Transcaucasia, has been able to state that the true home of *T. persicum* Vav. was precisely the centre of Transcaucasia, where he had determined four varieties of this new species.

The species *T. persicum* Vav. is characterized by the following peculiarities :— The ear is similar in its general form to that of *T. vulgare* Vill., but it differs from the latter by the fineness of its culm, by long parallel awns often longer than the ear, by a well filled straw and by a vitreous grain with silvery back.

From a cytological point of view *T. persicum* is characterized by 28 chromosomes and as regards immunity, it entirely resists attacks by *Erysiphe graminis* (grass mildew).

As regards hybridization, this species gives by crossing with *T. vulgare* almost or perfectly sterile hybrids.

The four varieties of this species discovered by the writer have the following characteristics.

1) *Trit. pers.* Vav. var. *stramineum* Zhukovsky, Spica alba, glabra, aristata, caryopsis rubida.

2) *Trit. pers.* Vav. var. *rubiginosum* Zhuk. Spica rubra, glabra, aristata, caryopsis rubida.

3) *Trit. pers.* Vav. var. *coeruleum* Zhuk. Spica coeruleo canescens, villosa, aristata, caryopsis rubida.

4) *Trit. pers.* Vav. var. *fuliginosum* Zhuk. Spica nigra, villosa, aristata, caryopsis rubida.

Fig. No. 133 shows the ears, the aristate glumes and the grains of these four varieties.

Fig. No. 134 shows the arrangement of the chromosomes in these four varieties, compared with that of *T. vulgare* var. *erythrospermum*.

The first three varieties are spring wheats ; the third is only found in small quantities in the damp mountainous regions of the province of Tiflis ; it drops its grain easily.

The variety *fuliginosum* appears in several forms, with long or short ears, with hollow or well filled culms, with grains falling more or less easily. It is one of these forms which has helped VAVILOV to determine the new species, *T. persicum*. The writer considers that the discovery of these varieties confirms the law of homologous series in variations mentioned by Prof. VAVILOV. The farmers of Transcaucasia only use seed of varieties of *T. persicum* for spring sowings, while the autumn sowings are always made with seed of soft wheats.

The *persicum* species do not stand wintering, even in the relatively

F. IX F. X F. XI F. XII

Fig. 133. — Varieties of *Triticum persicum* Vav.
F. IX — Var. *stramineum* Zhuk.; F. X — *rubiginosum* Zhuk.; F. XI — Var. *coeruleum* Zhuk; F. XII — Var. *fuliginosum* Zhuk.
a-b — glumes containing grain; *c-d* — back and side views of grain.

mild climate of Transcaucasia. On the other hand their quality of early ripening renders them particularly suitable for spring sowings.

IX. — M. MAKSIMOV undertook in 1920 a research on selection of wheat, which he has unfortunately been unable to complete, on account of the entirely insufficient means at the disposal of the experimental station of Rostov Nakhitchevan. He had selected in 1920 on the experimental plot of that station 156 plants of winter wheat, the seed of which he carefully collected. He preferred to make his selection in the experimental plot during the period of growth, in order to determine thoroughly all the peculiarities and the behaviour of the individuals which were to produce the lines destined for the selection research, instead of being content, as usual, to make a selection of seeds. These 156 individuals, forming a well known mixture common in the country under the name of " red

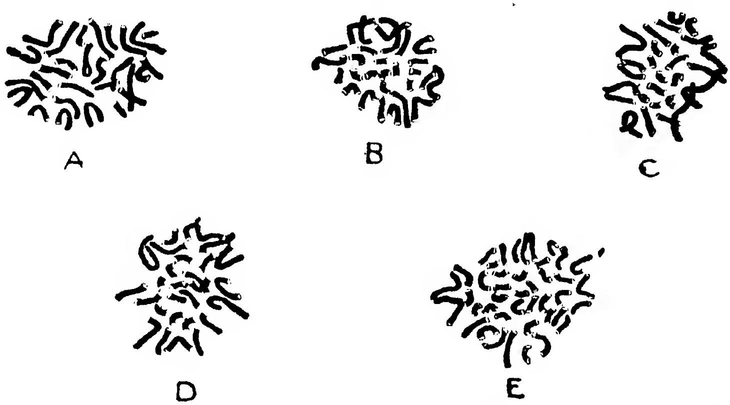

FIG. 134. — Chromosomes of different varieties of *Triticum persicum* — Var.

A = *Trit. persicum stramineum*
B = *Trit. persicum rubiginosum*
C = *Trit. persicum coeruleum*
D = *Trit. persicum fuliginosum*
E = *Trit. vulgare* var. *erythrospermum*.

bearded winter wheat " belonged to the following varieties of *Triticum vulgare* Vill. :—

erythrosphermum	32	individuals
nigro-aristatum	8	»
ferrugineum	26	»
sardorum	6	»
caesium	22	»
hostianum	11	»
barbarossa	24	»
lutescens	16	»
milturum	9	»
pyrothrix	2	»

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These plants were sown in the autumn of 1920 in an experimental plot and, after a period of growth under the most unfavourable conditions of intense drought which characterized the spring and summer of the year 1921 in Russia, their seed was carefully harvested, but the work of selection was stopped, as has been said, at this point.

Nevertheless observation of these plants during their growing period and analysis of their seeds have enabled the writer to formulate the following conclusions :— Local kinds of wheat certainly provide excellent material for the work of selection, both on account of the numerous varieties which enter into their composition and for the reason that many of these forms have given good results in experimental plots, in spite of the unfavourable conditions of the spring and summer of 1921.

The lines produced by the seeds of *hostianum* and *barbarossa* have given results which were not inferior to those of other varieties; consequently the commonly-held opinion that these two varieties are unsuited for growth in Russia should be again tested by further research.

X. — The terrible drought of the year 1921 in Russia, followed by the total or partial loss of the harvest in certain regions, necessitated the importation of large quantities of seed grain among which it has been possible to record the presence of new forms and varieties still unknown in the country.

Practical farmers as well as investigators have devoted great attention to testing and studying these new forms of wheat in the hope of finding among them kinds resistant to drought.

Among others hard spring wheat, known as "Polish" wheat, was imported and its growth highly recommended. The writer, M. NOSSATOVSKY, found that these seeds contained a large quantity (up to 50 %) of the variety *Triticum Chrysospermum*, which he subjected to research. This variety is indeed a typical hard wheat, belonging by the length and consistency of its glumes to the species *Triticum polonicum*, but is distinguished from it by certain characters. The culm is long and slender, the last internode is full of pith. The ear in white, not covered, 7.5 cm. long, the awns are 9 cm. long and their colour is the same as that of the ear. The ear contains 11 spikelets, most of which bear two flowers. The glumes are very long, up to 29 mm., and more delicate than those of other hard and soft wheats. The grain is 5-6 mm. long; it is therefore much shorter than in other varieties of *T. polonicum*; its colour is greyish red, its fracture vitreous, the weight of 100 grains is 3.2 gr. The most characteristic feature of this plant is that at the time of flowering the spikelets become detached and deviate from the stalk of the ear until they take up an almost horizontal position ; at the same time the glumes open and the gynaecium remains, entirely uncovered, without any protection against the wind and sun. This peculiarity renders the plant very susceptible to drought, from the point of view of its yield. In fact, the yield of *T. polonicum chrysospermum* is entirely inadequate ; this variety has only given an average of 1.49 q. per ha. in sample plot, while *T. vulgare lutescens* gave under similar conditions a yield of 5.44 q. per ha.

The writer concludes from this that the use of seed of *T. polonicum*

chrysospermum could not be recommended, especially in regions which often suffer from drought.

XI. — Mr. KOLMAKOV has recorded the presence of a considerable quantity of black bearded wheat in the winter wheat crops of the province of Stavropol. This variety is found in the crops in proportions of from 15 to 35 %. As it very much resembled the variety *erythrospermum*, it was thought that it was only a case of variation of form, or at most of a race differing from the ordinary forms only by the colour of its awns. A more through investigation has enabled it to be ascertained that it is indeed a distinct variety called *T. vulgare* var. *nigro-aristatum*. This variety has white naked ears, but furnished with black awns; the grain is red and vitreous. It is generally found mixed with the varieties *erythrospermum* and *ferrugineum*. Its examination, from the point of view of yield, has given very good results, generally even better than those of the two varieties which it accompanies; the same is true for its tillering capacity, its number of large grains, for the weight of 1000 grains and lastly for the number of grains harvested in proportion to that of grains sown. The writer has concluded that the variety *nigro aristatum* may furnish good material for selection from the point of view of productivity.

XII. — M. TERNOWSKI communicates the results of a botanical analysis, from a morphological, biological, anatomical and physiological point of view of a series of specimens of wheats collected by the experimental station of Stavropol. He gives the characteristics of 11 varieties of *Triticum vulgare*, of 16 varieties of *Triticum durum* and of 1 variety of *Triticum compactum*.

XIII. — Having at her disposal a rich collection of seeds of Aegilops from Turkestan and Persia, Mme POPOVA made a detailed study of them to determine the principal varieties with well defined and hereditary characters. The seeds belonged to four species, namely :— *Aegilops triuncialis* L., *cylindrica* Host., *squarrosa* L., and *crassa* Boiss. The writer determined in this collection 9 varieties of *Aeg. triuncialis*, 6 varieties of *Aeg. cylindrica*, 3 varieties of *Aeg. squarrosa* and 7 varieties of *Aeg. crassa*. She thinks that other varieties of *Aegilops* may yet be eventually found, and that the study of races, which she proposes to deal with, will give much more abundant material.

What is to be remembered for the present is that there exists a striking parallelism between the variability of species of *Aegilops* and that of species of cultivated *Triticum*. We find in *Aegilops* as well as in *Triticum* aristate and beardless varieties, smooth or hairy; with white, red and brown ears, etc. We know that hard wheats are little, or not at all, subject to rust (*Puccinia glumarum* and *P. triticina*) and that their culms are more solid and often filled, while soft wheats are not resistant to that infectious disease and their culms are hollow. Now these same peculiarities are found in *Aegilops*, in which the species *triuncialis* has filled culms and does not suffer from rust, while the species *cylindrica*, *squarrosa* and *crassa* are very subject to it and have hollow culms.

The writer has also found that *Aeg. triuncialis* is better suited for crossing with hard wheats while soft wheats are crossed more readily with

the other three species of *Aegilops*. He infers from this a complete parallelism of variability between the species of *Aegilops* which grow wild and those of cultivated wheat, which shows that cultivation has no effect in this respect. Experiments of hybridization between *Aegilops* and *Triticum* have been made for a long time and the results are well know. But it has hitherto always been a case of artificial crossing. Now, the writer has recorded in Turkestan, where the genus *Aegilops* is very common in the wild state, a series of cases of natural or spontaneous hybridization between these two genera. Uncultivated land produced a rich growth of *Aegilops*, which gave rise to numerous plants between the wheat furrows as well as on the edges of the furrows. Crossed pollination resulted which produced a great number of hybrids. Most of these were sterile and out of over 300 plants the writer only found 7 which produced seed to the extent of a single seed per plant. Four of these seeds failed to germinate, while three gave rise to plants which grew normally. Two of these young plants after forming ears had an appearance very similar to that of *Aegilops cylindrica*, but the third distinctly showed all the characters of a perfect hybrid. In all probability the parents were on one side *Aeg. cylindrica* and on the other *Triticum vulgare* and the third hybrid had characters intermediate between these two species. The figure 135 represents two specimens of natural hybrids, one of which comes from the spontaneous crossing of *Aegilops cylindrica* with *Triticum vulgare*, and the other from that between *Aegilops crassa* and *Triticum vulgare*.

XIV. — M. DROSDOV has studied a series of specimens of *Triticum monococcum* growing wild in the Crimea near Balaclava. This spontaneous growth was in the presence of numerous plants of *Agropyrum cristatum*, *Festuca ovina*, *Aegilops cylindricum* and *Aegilops ovatum*, all typical plants indicating virgin soil.

The varieties which he determined were :— *T. monoc. boeticum*, *Pancici* and *Larinovi*.

Triticum monococcum is found as a cultivated plant in two regions near Simferopol where the Tartar population sow it as a spring crop for making gruel.

The writer has recorded 4 varieties of this plant, namely, *T. monoc. Symphairopolitanum*, *tauricum*, *eredvianum* and *Hernemanni*.

He thinks that in spite of the inferiority of this grain its growth will still be practised by the Tartars of the poor mountainous regions for a long time. The cereal has, indeed, the advantages of being very resistant to disease, drought and frost, of only needing a rudimentary cultivation and of being content with a marly stony soil.

XV. — Mr. FLACHSBERGER has discovered a new variety of *Aegilops triuncialis* with black awns, whihc he has named *Aeg. triuncialis nigriaristata* and of which he gives the following description :— *Spica aristis nigris vel nigriscentibus. Prov. Transcaspica distr. Askhabad in jugo Kapet Dagh.* He remarks that this discovery shows a fresh confirmation of Prof. VAVILOV's law on homologous series in variation, since varieties of *Triticum* with black awns are well known.

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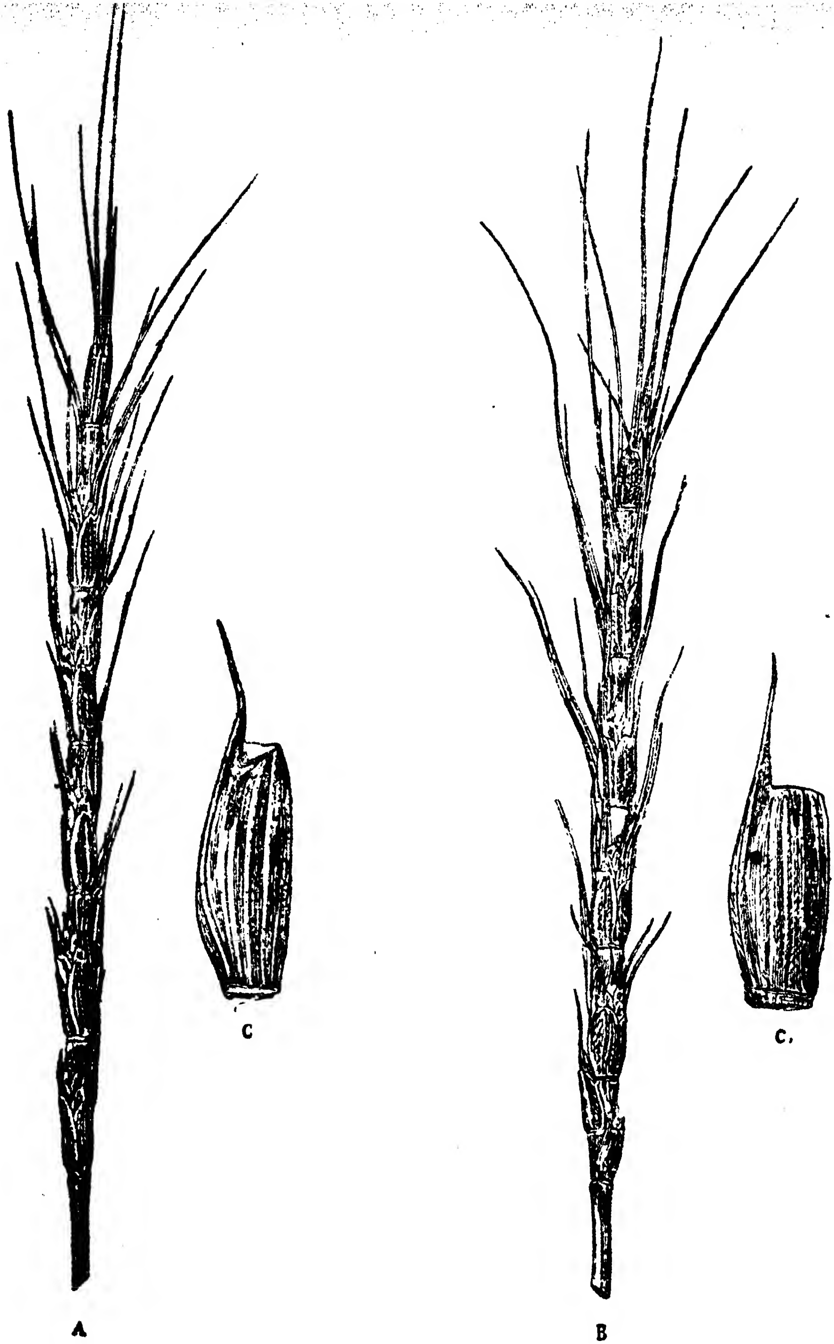

FIG. 135. — A = Natural crossing: *Aegilops cylindrica* × *Triticum vulgare*.
B = Natural crossing: *Aegilops crassa* × *Triticum vulgare*.

617. **Hard Grain Texture as a basis for improving the quality of Early Baart Wheat.**

BRYAN W. E. and PRESSLEY E. H. (Arizona Agricultural Experiment Station). *Journal of American Society of Agronomy*, Vol. XVII, No. 7, pp. 441-443. Geneva, N. Y., 1925.

The term " high quality " of wheat usually implies a grain which produces a high percentage of flour of good baking strength.

Early Baart wheat was imported from Australia, and has been the leading variety in Arizona far at least ten years. At the Agricultural Experiment Station, in the autumrn of 1920, a pedigree strain of Early Baart, No. 34-14, was planted. Some of the seeds were found to be very hard and glassy, while the remainder were soft.

In order to test the stability of the hard texture grain, a single row of 19 plants was planted from the hard seeds, and another row from the soft seed of the same strain. Of the 19 plants from hard seeds, 10 plants only had hard grain.

It was found that grain texture constituted the only visible difference between the hard and soft strains. From each of the ten hard-grained plants a pure hard strain has been established, and these strains have been grown for four years under irrigation, and are as hard as the grains originally selected.

Milling tests of the hard strains have been made from the 1923 and 1924 crops ; the hard strains differ from the soft in two factors only, absorption and percentage of gluten. The hard strains are about 6 % higher in absorption and 2 % higher in gluten than the soft Baart. The higher absorption of the hard strains gives a greater bread yield. W. S. G.

618. **Quantity and germinating power of wheat in relation to the threshing period.**

MORETTINI, A. Influenza dell'epoca della trebbiatura sulla quantità e germinabilità del frumento. *Le Stazioni sperimentali agrarie italiane*, v. LVIII, p. 1-6, p. 161-182, bibl. Modena, 1925.

From the time of reaping until threshing wheat is kept in the ear and stored in different ways according to the district. During the said period it may suffer injuries varying with the year by the operation of different agents. Among these may be enumerated :— the phenomenon of the germination of the grain in the ear, dependent on well determined changes of weather, and more especially damage by insects which considerably and seriously affects the quantity and quality of the grain as well as its germination.

The researches made by the writer in the middle Valley of the Tiber (Umbria) tend to prove conclusively that mechanical threshing, done with common threshing machines for soft wheats, does not sensibly injure the power of germination and that the grains broken by the thresher do not usually exceed one per cent. On the other hand, the damage which occurs to wheat owing to delay in threshing (beyond 26 days from reaping)

is serious, because we then get invasion by the larva of *Sitotroga cerealella* which, in certain years, may reduce the germinating power of the grain to 30 % and cause a loss in weight of 15 %. The importance of this damage generally escapes notice, because, with winnowing and sifting, a large part of the damaged grain is eliminated with the chaff and taken away with the refuse. It is therefore advisable to thresh as early as possible.

By means of mechanical sorting, and especially by winnowing, a lot damaged by *Sitotroga* may be improved so as to render the grain fit for sowing, but only if the attack is slight. A. F.

619. **Research on variability in the " Burt " oat.**

COFFMAN, F. A., PARKER, J. H., and QUISENBERRY, K. S. (Office of Cereal investigation, Bureau of Plant Industry). A Study of Variability in the Burt Oat. *Journal of Agricultural Research*, vol. XXX, No. 1, p. 1-64, 9 tab., bibl. Washington D. C., 1925.

The " Burt " variety of oats is one of the chief red oats and it is regarded as having been created by a certain BURT, hence its name. It is widely adaptable and grown for industrial purposes in the South-West of the United States. It is very subject to variations and difficult to classify ; probably the varieties known under the names of " May ", " Early Ripe " and " June " belong to it. It has a great economic value by reason of its wide adaptability, early ripening and resistance to rust and smut. This variety has been classified as *Avena sativa* and as *A. sterilis*. According to the writers it belongs to *A. byzantina*, the species in which European taxonomists include the cultivated descendants of *A. sterilis*. It certainly contains some stock much resembling *A. sativa*. It is however not improbable that many spontaneous crossings have taken place.

Besides the character of the spikelets which are of very great importance, the writers have observed that this variety undergoes variations in various characters, such as in the *habit* of growth of the young plant, in the colour and size of the leaves, in the time of ripening, etc.

There are also distinct variants, among them one showing a pale condition of leaf, another with many flowered spikelets, one with free glumes, etc.

The writers show the utility and possibility of isolating relatively pure stocks, by continuing selection for several years. A. F.

620. **Bean Culture in Norway.**

BREMER A. H. *Meldinger fra Norges Landbrukshøiskole*, No. 7, 1924, pp. 317-366, bibliography. Oslo, 1925.

The growing of *Phaseolus vulgare P. multiflorus*, and similar varieties of beans has increased rapidly during the past twenty-five years, owing to the successful results of plant-breeding, which has placed on the market new varieties especially suited to Norwegian climatic conditions.

Amongst dwarf beans, the varieties " Nordstjer " and " Alabaster "

have proved the best. The Norwegian strain of Erstling "Reistad" gives a high yield and ripens early. Early maturity is very important owing to the shortness of the summer, which makes it very difficult to obtain well-ripened seed, also the failure of seed to germinate from damage caused by disease is a serious difficulty. W. S. G.

Tropical and other commercial plants.

621. **Cotton growing in Cilicia.**

VILMORI, P. L. de. La culture du cotonnier en Cilicie. *Revue d'Histoire Naturelle appliquée*, v. VI, No. 2, p. 53-64, Paris, February 1925.

The writer examines the general conditions of the region which occupies an area of about 50 000 square km.: the growth of cotton there is nothing new having been introduced from India, but its exportation dates back to about 20 years ago. In 1908, 60 000 bales, of about 2 quintals, were exported: in 1912, 100 000 bales, 120 000 in 1913 and 135 000 in 1914. Consequent to the outbreak of war, production fell to 15 000 bales in 1915, 18 000 in 1917, 15 000 in 1918, in 1919 to 24 000 and in 1922 to 28 000. The writer, in 1924 when he made his journey of investigation in the region, estimated the crop at about 60 000 bales.

The species grown are: *Gossypium herbaceum* and *G. hirsutum*. The former species is called "yerli" and was introduced about a century ago; it is grown without selection, sown broadcast, with primitive methods, so that the yield is rather small, not exceeding 50 kg. per ha.: the capsules, have the peculiarity of being but slightly dehiscent and the seeds are fairly adherent to the capsule; these characteristic peculiarities enable picking to be spread over a long period of time, and done when convenient, while the removal of the seeds is done by hand by women in winter: in a country where manual labour is so scarce these peculiarities have the greatest importance.

G. hirsutum (Upland type with short staple), called "yanè", was introduced about 40 years ago: it does not present appreciable modifications, but is less productive.

In Cilicia, it is not really possible to distinguish special cotton zones, as cotton is grown everywhere. The best soils are the argillaceous alluvial soils containing up to 20 % o carbonate of lime: their colours vary from grey (presence of much carbonate of lime) to black and red, the red soils containing salts of iron and chromium. Subterraneous water is abundant throughout the Adana plain, thus the cotton, owing to moisture in the sub-soil, can stand the extraordinarily dry summers. The cultural methods are rather primitive: the Germans, during the war, taught modern methods, consisting especially in deeper tillage of the soil, and large proprietors carry out deep tillage with machines, but according to ACHARD, this is more injurious than useful, as helping the dessication of the subsoil.

Chemical manures are not used: stable manure is used in nurseries, rarely for large crops, but this stable manure has little value, because it contains not straw but fine earth.

The growth of cereals follows that of cotton. In some regions, owing to scarcity of manual labour excellent land is obliged to be left uncultivated for one or two years. "Bersim" and the groundnut might be introduced into Cilicia with good results. The principal cotton pests have come from America : *Earias insulana*, and *E. faba*, *Harpator iracundus* and lastly the pink boll worm or *Gelechia Gossypiella*. The methods of preparation of the land are as yet imperfect ; the removal of the seed is effected for large crops with the Platt machine with cylinders.

The principal types of Cilician cotton are :— Yanè, Kapoumali, Supérieur, Extrissima, Extra (these last four belong to the "yerli" cotton).

On the 22nd December 1924, the price of Good Middling at Havre being 880 frcs. per 50 kg., their values were :— Yanè 670-680, Kapoumali 650, Superieur 640, Extrissima 625, Extra 610.

Cilicia is therefore a region fairly near to Europe, and within easy reach and with a great future for cotton. If Turkey lives in peace for a few decades its production might be estimated at not less than 80 000 tons. But great improvements must be made, especially in cultural methods.

F. C.

622. **Gums and balsams of Indochina.**

CREVOST, Ch. *Bulletin Économique de l'Indochine*, year XXVIII, No. 172, 1925-III, p. 283-317, 16 pl. Hanoy, 1925.

The economical review of Indochina, continuing the publication of the catalogue of the products of Indochina, has published the part dealing with the gums and balsams of Indochina.

A) *Gums.*

Gums are substances soluble in water, with which they form thick and fibrous mucilages. They are divided into three classes :

I. — *Real gums* (*type gum-arabic*). These swell rather in water, and dissolve entirely or partially.

II. — *Mixed gums* (*pseudo-gums*). Their solubility is small. They swell considerably in water without dissolving *e. g.* Tragacanth.

III. — *Tanno-gums or Kino* containing, besides the elements which form mucilaginous solutions with the water, also gallic acid and tannins. The author has adopted for the study of gums a classification into botanical families :

Biscacées : *Cochlospermum gossypium* D. C., var. *cambodiana* Gagnep : its gum is a product to be studied.

Guttiferous : Gutta-percha. Indochina counts no less than 22 kinds of *Garcinia*, of which most on being cut produce gums of different sorts, more or less coloured and consequently more or less capable of use.

Among the gums, special attention must be drawn to the gutta-percha which forms an excellent commercial product of Indochina. It is found in the following trees :

Garcinia Hamburyi, Hook, f. ; syn. *G. morella*, var. *pedicellata* Hamb., a tree, 10-15 metres high, found in Cambodia in the provinces of Pursat. Kompongspen (Khands of Somrong-tong and of Thpong), of Kampot, etc, and on the Phu-quôc island.

According to certain Cambodians, 50 trees produced 37 ½ kgs. in 5 months or 0.750 kgs. per tree every two years. A Chinese buyer who was in close touch with a settlement using this product, told PIERRE that the production of one tree was not less than 2 kgs. This tree, which he pointed out as being able to give that production, was 32 years old, already exploited and its bark had a thickness of 4 mm. PIERRE has actually seen trees, 10-12 years of age, whose diameter was not more than 6 cm and which already had been tapped. Consequently he thinks it possible to start tapping *garcinias* when they are 5 or 6 years old. Gutta-percha is completely dissolved by the action of ether and water ; it is used for colouring numerous spirit and turpentine varnishes ; it is also used in water colour painting. One finds in the market of Saigoun two qualities of gutta-percha, the first quality gum is nearly pure, its breaking is conchoidal, smooth, and brilliant, the colour dark yellow-orange, becoming light yellow when one rubs it with a wet finger. It is sold in cylinders of a diameter of 3-4 cm. and a length of 12-15 cm., the second quality gum is spoiled by scraps of bark ; it is sold in irregular lumps or in small pieces. The average annual export from Indo-China of Gutta-percha during the years 1919-1923 was about 13 700 kg.

During 1923 the exports amounted to 17 000 kg. of which 11 000 kg. were to Singapore, 3200 kg. to France, 1350 to England, 1000 to Hongkong and the remainder divided between Belgium and Siam.

1st class gutta-percha was in Cochinchina valued at 250 piastres per 100 kg. in December 1924 ; the price of the second quality is generally from 30-40 piastres less.

Garcinia Gandichandii Planch. and Triana, a forest species 3-10 metres high. — Cochinchina, Annam and Laos — Seldom cultivated.

Garcinia tonkinensis Vesque, a beautiful tree, cultivated in Tonkin for its oil-seeds and not for its gum ; the last according to Dr. F. HEIM might be of great interest for the stiffening and the printing of textile fabrics.

Sterculiacees. — Some Sterculia, among the 30 kinds known in Indochina, produce now and then a white-yellowish gum, which the Annamites are very keen on taking, as their pharmacopoeia appreciates it highly for chewing.

Rutacees. — The gum-producing Rutacees are very numerous, those worth notice being : *Aegle marmelos* corr — *Feronia elephantum* corr. — *Zanthokylum piperitum* D. C.

Meliacées — *Melia azedarach* L. (Japanese lilacs) and *Melia azadirachta* L. These two kinds are spread through the different countries of Indochina ; they are planted in the middle and at the sides of the roads. Some planters of Tonkin have made special plantations of *Melia azadarach* : the nature of its wood and its rapid growth make it very suitable for the construction of mine-galleries.

One fairly often sees long gum drops on the trees, light-yellow in colour and brilliant, and these dissolve almost completely in water.

Chukrasia tabularis A. Juss. Anacardiacées — *Buchanania latifolia*, Roseb. A very common tree in all the southern parts of Indochina, Burma and India with seeds having a taste of pistacchio. According to J. de CORDEMOY, the gum of this tree is very highly appreciated in India. A well grown tree could yearly give a little more than 2 kg. The gum is crumbly, of a light colour or pale brown, tasteless ; it is largely soluble in water. The solution, which contains only a small proportion of insoluble elements, possesses adhesive qualities, quite comparable to those of gum arabic. The author thinks that this product might attain a real commercial value :

Odina Wodier Roseb. *Bonea burmanica* Griff — *Anacardium occidentale* L.

Leguminosae. — It is the *Acacia* genus and specially the African kinds of this genus, found in Egypt, in Soudan, Senegal and along the coast of Somaliland up to the Cape of Good Hope, which gives the European markets their biggest supply of gum arabic. Indochina has got about ten sorts of *Acacia*, wide-spread through her territory, but the absence of research on the subject makes it impossible at the present moment to give any indication of the nature of the gum of these trees: Among the best known sorts the author mentions :

Acacia Farnesiana, Wild. — *A. arabica* Wild. — *Butea frondosa* Roxb. (the gum of this tree is very rich in tannin) *B. superba* Roxb.

The following kinds are also mentioned : *Pterocarpus indicus* Wild. — *Pt. pedatus* Pierre — *Pt. cambodianus* Pierre — *Pt. macrocarpus* Kurz.

Lauraceae. — Some lauraceae possess in their wood gum-mucilaginous substances, which, though they are not be found on the bark of the tree in a state of secretion, are not less interesting to commerce. Such is the property of *Litsea sebifera* Pers. A tree of about 12-15 metres high, well known in Indo-China and cultivated in certain provinces (provinces of Nord-Annam) for the use of its oil-seeds, which on being crushed yield a concrete yellow material, serving for lighting purposes.

B) *Balsams.*

The pharmacologists, agreeing with the chemists, restrict the denomination of the balsams to the natural products, of which the average composition is the following : resin, volatile oil, and one or more acids of the aromatic series, generally benzoic acid and cinnamic acid.

Benzoin. — The Indochina economic agency at Paris has recently published a study on the benzoin of Indo-China, called " Benzoin of Siam ". The sort observed at Tonkin by BALANSA (*Authostyrax tonkinense*) should correspond with the *Styrax tonkinense* of PIERRE, " Bô-dê " of the Tonkinese, and this sort, cultivated in Laos for its benzoin under the name of " Kok Nham ", would appear to be much more widely spread. It is to be found in Tonkin, in the provinces of Hoà-binh, Sonla, Phu-tho, Thài-nguyên, Tuyên-quang Yên-bay and those of Nord-Annam, where

it is only cultivated to supply the wood for making matches. *Styrax tonkinense* Pierre = *Anthostyrax tonkinense* Balansa.

Benzoin gives out a fine perfume, somewhat like that of vanilla, a quality making it much in demand for the making of perfumes. It melts in the fire, spreading a very strong odour, it is soluble in alcohol and ether.

Indochinese exports of benzoin during the period 1909-1923.

Year	Quintals	Year	Quintals	Year	Quintals
1909	239	1914	162	1919	410
1910	265	1915	162	1920	265
1911	502	1916	76	1921	176
1912	1 126	1917	52	1922	396
1913	1 336	1918	4	1923	377
Total . . .	3 558		456		1 624
Average annual export.	715		91		325

The exports during the year 1923 are divided as follows:

Laos, by Tonkin, 201 quintals;

Laos and Cambodia, by Cochin-China, 176 quintals.

The benzoin of Laos follows many trade routes: the production of the Hona-Phans, formerly nearly entirely directed along Thanh-hoa (Annam) by Sam-Tu, takes more and more the road of Cho-bo (Tonkin).

The buyers even send their agents on the roads leading to the market in order to get the material, before it reaches that place; on the other hand part of the production of Luang-Prabang is forwarded to Cochinchina, while another lot passes the Indochinese frontier to be shipped at Bangkok, where it raises the export quota of this country under the commercial name of "Benzoin of Siam".

The packing of the benzoin is a very delicate operation, as it is apt to break very easily and especially to form into lumps: it is a commodity which must be labelled: "to be kept away from the boilers".

The exporters take very great care in packing: some wrap the layers of the three first qualities in very soft native paper and afterwards in tin plate boxes; others wrap the boxes containing the different kinds round with paddy husks in order to weaken the influence of the heat which might cause the drops and especially the small scraps to form into lumps.

P. C.

(Correspondence Bureau of Indochina).

623. **Variations in the sugar content and in the rate of growth of beet in consequence of rain.**

URBAN, J. (Forschungs-Institut der Csl. Zuckerindustrie). Ueber Aenderungen im Zuckergehalt und in der Wachstumsgeschwindigkeit der Ruben als Folge verschiedener Wasserniederschläge. *Zeit. f. die Zuckerindustrie der ce-*

choslovakischen Republik, Year XLIX, No. 39-40, p. 299-305 and 307-312, 1 fig., 10 tab. Prague, 1925.

The writer has made use of data furnished by 6200 analyses made during five years in sugar factories in Czechoslovakia and has correlated the analytical results with the rainfall conditions. It is observed that the sugar content shows its maximum increase after a dry week preceded by a wet one (20 mm.) ; this increase was on the average 0.80 % and in one year amounted to 1.19 %. When a dry week was preceded by another dry week, the increase was 0.75 %.

With continuous rain, the gain in sugar content is reduced with a certain regularity so that, after a rainfall of 27 mm., the sugar content remains as it was at the end of the first week and is reduced below this limit after still heavier rain.

There may be a decrease in the sugar content also with a rainfall less than 27 mm., when the beet has a scanty sugar content and the leaves have withered The decrease in sugar content caused by abundant rain averaged on the five years 11 % with 35 mm. of rain ; in a dry year (1921) it amounted to 1.12 %.

The sugar content is more stable, that is it resists the decrease better, when the root and the leaves are well-developed and fresh. Vice versa. the more the beet is dried up, the more easily the sugar content decreases after rain, in consequence of the weakening of assimilation in rainy weather. As regards the *rate of growth*, it is observed that this varies in direct proportion to the rainfall of the same week and of the previous week. The smallest weekly increase (g. 20.7) was observed in the average of the five years during a dry week preceded by another dry week. With continuously increasing rain, the rate of increase in weight of the root becomes quicker, though it slows down again afterwards. The greatest weekly increase (g. 38.3) was observed in sunny weather after a heavy rainfall of 37 mm., when therefore the beet had sufficient moisture.

The greatest elaboration of sugar in the root took place in a dry week preceded by a wet one. The best conditions for the production of sugar exist when, after a rainy period, the weather becomes fine ; in such a case the average weekly increase was g. 7.62. On the other hand during a rainy week the production of sugar fell in such a degree that during a rainfall of 35 mm. the gain in sugar was only g. 4.89 or 64 % of the maximum production. In the same conditions the elaboration of sugar is smaller when the leaves are less developed. A. F.

624. **Tests of Sugar Beets.**

DOWN E. C. *Michigan Agricultural College Experiment Station Bulletin* No. 66, p. 8, tables 6. East Lansing, Mich., 192.

The Bulletin contains a report on three years' work on 23 samples of sugar beet of different varieties and from various sources. The average yield, sugar percentage, purity coefficient and total sugar recoverable are given for the strains tested.

The average total sugar recoverable per acre for the leading varieties was: German Elite 2242 lb., Zapotel Seed 2138 lb., Czecho-Slovakia 2106 lb., Canadian 2090, G. D. Z. 2074, Michigan Grown 2000.

Michigan grown seed from commercially grown foreign seed, without selection, results in a beet with comparatively high tonnage, low sugar and low purity.

A variety of sugar beet should not be grown because of high sugar content alone, but should be tested for tonnage and purity coefficient.

W. S. G.

Horticulture and forestry.

625. **Frnit growing in Italy.**

BASSI, EDOARDO. Frutticoltura italiana. One vol. 16°. p. 358. figs. C. Tarantola ed. Piacenza, 1925.

The principles and informative criteria to which modern fruit-growing arboriculture must be subjected are expounded in this volume.

The first part contains ideas of general fruit-growing, types of fruit-farming and methods, the care to be given to the trees; with a widely developed discussion on pruning. The second part is devoted to special fruit-growing and deals with trees bearing stone fruits (peach, apricot, cherry, plum) and fruits with pips (apple, pear). Hints on methods of cultivation, harvesting, packing, preservation and especially regarding diseases are given clearly. In recapitulatory chapters, at the end, the Author, in addition to dealing with the manuring of fruit trees and arboreal medicine, gives standards for ascertaining the productivity of an orchard and suggests a radical reform in the propagation of fruit trees, based on the genealogical selection of the grafting stock.

A. F.

626. **Orange grafting in Suriname.**

STAHEL, G. Het veredeln der sinaasappels in Suriname. *De Indische Mercur*, year 48, No. 2, p. 15-16, fig. 12. Amsterdam, 1925.

The necessity of a greater production of oranges in the Dutch Indies was specially felt during the war when European markets were closed. Now oranges from the Indies are being sent to Europe, but they have to meet competition, especially of South African oranges, hence the necessity of arranging for a good and more especially a standardized production.

Among the various varieties "Washington Navels" is not recommendable because the fruit is not juicy. "Lambs summers" gives good fruit, but it is only suitable for local consumption, because the thin skin soon becomes hard and leathery and prevents export to a distance.

For important varieties it is therefore better to have recourse to local kinds, among which there are some which produce fruit of very good quality; among these may be mentioned the varieties:— Sorgoiiet, La Liberté and Kwatta. There then remains the question of stock for grafting on to, for which the bitter orange and the "alamoen", a variety of *Citrus de-*

cumana, are recommendable. The latter, indeed, in the damp climate of Suriname, easily becomes subject to the gum disease, but other varieties are still more easily attacked by this disease.

As regards the method of grafting the cutting like an inverted T is advisable ; but this is not suitable for the " alamoen " for which FORKERT's method is followed. A. F.

627. **The natural laws of sylviculture.**

MAYR, H. Waldbau auf naturgesetzlicher Grundlage. II. edition. 1 vol. in 8vo p. 568, 27 fig. and 3 tab. P. Parey, Berlin, 1925.

The first edition of this book, published in 1908, aroused great interest and caused keen discussion, as happens to all works which give new impulses to currents of thought. But the foundations of sylviculture established in it by the author were so sound that the editor, on the advice of experts, decided to publish this new edition without changing a word of the original writing.

It is pleasing to note here, as agreeing with the guiding principle of the International Institute of Agriculture, the fact that MAYR correctly pointed out that the fundamental laws of sylviculture are international. And it is precisely for this reason that this treatise, henceforth a standard work, will be read and consulted with profit by anyone, in every country, who is interested in vital questions of sylviculture. A. F.

628. **The effect of grass undergrowth on trees.**

HOWARD, A. (Institute of Plant Industry, Indore). Effect of Grass on Trees. *Proceedings of the Royal Society*. v. 97, p. 284-321, 6 tabl., bibl. London, 1925.

In meadows and pasture lands of temperate regions, trees flourish even when surrounded by numerous grasses which are an artificial product created by man from the original forest and maintained by cutting and manuring. In tropical regions, on the other hand, where pasture lands are scarcer, land covered with grass when protected from animals, quickly becomes covered with shrubs and trees. Although the trees tend to eliminate the grass, in cases of a natural struggle, it sometimes happens that the grasses are capable of suppressing the trees. In various parts of the world, it is noticed that pear trees, apples and cherries do not thrive when there is an undergrowth of grass, if the soil is a heavy clay. The cause of this failure to thrive has been attributed by some people to a soil toxin which however has never been isolated.

Ill effects are lacking or are reduced to a minimum in well aerated and permeable soils, while after all it is certain that under natural conditions the grasses could not hold out against the trees.

The writer has investigated the problem by experiments at Pusa, which is situated on an old alluvium of the Ganges, examining various species of fruit trees. He observed that there were really deleterious effects when the trees were young ; less injury was experienced on the other hand by mature trees. When artificially trenched, some trees, such as

the mango, the loquat (*Eriobotrya japonica*) and the lichi (*Nephelium Litchi*) may recover, while others, such as apple trees, *Citrus medica* and *Anona squamosa* do not feel any effect. The guava (*Psidium Guyava*) can grow fairly well even with an undergrowth of grass and does not feel any effect from aeration. When the causes of these phenomena are investigated, it is observed that the grasses only have an effect on the superficial root system of the tree and not on the deep root system; this effect is shewn in the reduction of the growth of the superficial roots and of the number of active rootlets. Now at all seasons and under all conditions the various root systems show a considerable reaction to improved aeration. Even during the dry season, when the permeability of soil is at a maximum, the deep roots continue to ramify and to form abundant rootlets which grow in the various cavities and in the deep strata. After the rains, the superficial root system becomes markedly aerotropic and enteres into a phase of activity. This is the period of active nitrification and of growth of the leaves and of the trunk. Now the grasses become injurious either by restricting the aeration of the superficial rootlets during the rainy season (monsoon), or by reducing the provision of combined nitrogen during the whole year. There would then be the toxic effect of carbonic acid which accumulates in the soil during the rains, and the decrease of the provision of nutritive material (nitrogen). This explains the good effects which may be obtained in certain cases where trenching is done and those following nitrogenous manuring, which last however is ineffective in the case of the lichi and loquat. The possibility of the injurious effects being due to a hypothetical toxin, may be excluded.

A. F.

CULTIVATION METHODS AND MACHINERY

Irrigation

629. **Use and Waste of Irrigation Water.**

SMITH G. E. P. *University of Arizona, Agricultural Experiment Station Bulletin No.* 101, pp. 17, figs. 10. Tucson, Arizona, 1925.

The Bulletin contains much useful information and concludes with the following suggestions for farmers employing irrigation water:

Keep the ditches in order; line the ditches with concrete or lay cement pipes and so avoid loss by seepage; grade the land surface evenly; plough deeply; use short lengths of land for light soils; divide a large head of water into "unit heads" so as to get uniformity of irrigation; test the soil the day after irrigating to find the depth of water penetration; irrigate before planting; do not over irrigate; do not hesitate to irrigate at night, the evaporation being less at night; irrigate at the most favourable

time, alfalfa when two-thirds grown, maize when in tassel ; examine the soil occasionally for texture and moisture; cultivate the soil, a loose surface prevents baking and cracking ; eradicate weeds ; use a crop rotation containing alfalfa ; do not irrigate the roads ; measure the water to ascertain how much you receive and how much each crop uses. W. S. G.

630. **Studies in Soil Cultivation.**

I. KEEN B. A. and HAINES W. B. (Rothamsted Experimental Station). The evolution of a reliable dynamometer technique for soil cultivation experiments. *Journal of Agricultural Science*, Vol. XV, Part 3, pp. 375-386, Plate I, Figs. 3. London, 1925.

II. HAINES W. B. and KEEN B. A. A test of soil uniformity by means of a dynamometer and plough. *Ibidem*, pp. 387-394.

III. HAINES W. B. and KEEN B. A. Measurements on the Rothamsted plots by means of dynamometer and plough. *Ibidem*, pp. 395-409, Plates 2, figs. 6.

An account is given of a reliable technique for making dynamometer measurements in the field, a description and illustration of the dynamometer being supplied. It was shown that small variations in the drawbar pull are significant and correspond to actual variations in the resistance of the soil. No significant change in drawbar pull is produced by imperfect adjustment in the set of the implement within limits met with in ordinary ploughing. The slope of the land is without appreciable effect on drawbar pull up to gradients of 1 in 40.

The drawbar pull increases with speed, but the percentage increase is relatively so slight that saving in labour and other costs should result if the speed of ploughing were increased.

The general conclusion can be drawn from the results that, during a steady run with tractor and plough the variations in drawbar pull can be entirely ascribed to variations in soil texture, or soil resistance.

The unit consisting of tractor-dynamometer-plough should therefore prove useful for making field surveys of soil conditions and characteristics.

II. The site chosen for the experiment was a field known as Sawyer's covering about 6 ¼ acres recently taken into the area of the Rothamsted experimental farm. The field was level and showed no obvious irregularities.

The results have been shown in graphical form, lines indicating regions of equal drawbar pull. The figure has the appearance of an ordinary contour map (figure 1) the " hills " and " valleys " representing regions of high and low drawbar pull, the range of variation being about 40 %.

The results indicate large variations over short distances. The importance is emphasised of assuring and allowing for such variations before drawing conclusions from the drawbar pull recorded by different implements.

III. The authors have drawn maps of soil resistance to ploughing

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made during several seasons, on the Rothamsted classical plots, carrying wheat, barley and roots respectively.

The conclusions as to the effect of manurial treatments are only of a general nature at the present stage of the work, but such differences are certainly small in comparison with natural variations in the soil.

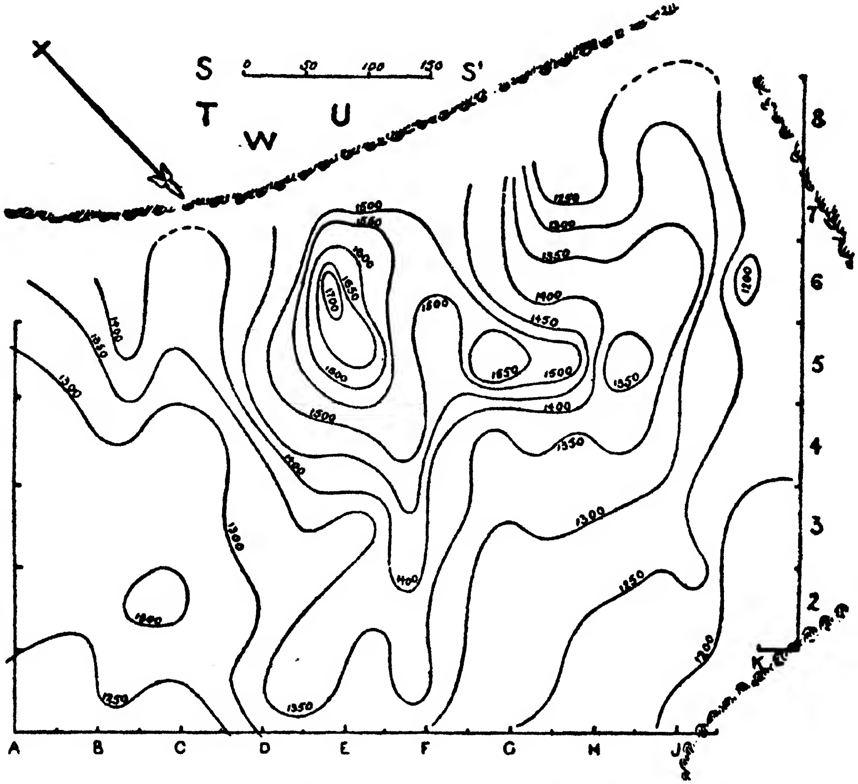

FIG. 136. — Graph of experimental field Showing lines of equal drawbar pull (isodyne contours in lbs.)
S — S' = scale in feet.

In the case of the Broadbalk wheat plots the drawbar pull values have a close relationship with the clay content of the soil and with certain aspects of the soil drainage. W. S. G.

631. **A Study of Native Ploughs in the Philippines.**

TEODORO A. L. *Philippine Agriculturist,* Vol. XIV, No. 3, pp. 135-142, figs. 3. Los Baños, Laguna, 1925.

The author gives details respecting some typical Filipino ploughs, with illustrations of the complete implements and the various parts.

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It is interesting to note that the share never governs the width of the cut, which is controlled by the mouldboard, whereas in the American plough the share determines the width of the furrow.

An account is given of some preliminary draft tests. W. S. G.

ECONOMICS

632. **Cost of Producing Field Crops in 1923.**

COOPER M. R. and HAWLEY C. R. *United States Department of Agriculture Circular* No. 340.

The report gives details of an enquiry into costs of production of maize, wheat, oats, potatoes, and cotton during 1923. The study is based on replies to a questionnaire sent to crop and livestock reporters in all the States.

The reports on wheat showed an average gross cost of $22.88 per acre allocated as follows : preparation of seed bed, planting, harvesting and marketing, 45 % of cost ; fertilisers 11 % ; seed 7 % ; land rent 26 % ; miscellaneous items 11 %.

The average sales value per bushel was $0.99 and the value per acre was $4.38 less than the cost per acre, hence farmers did not receive sufficient income from the 1923 wheat crop to repay them the cost of production.

This work is to be continued, so that in course of time indices will be available for making comparisons of yearly costs of production of the principal crops. W. S. G.

633. **The Legume Problem.**

OAKLEY R. A. Economics of Increased Legume Production. *Journal of American Society of Agronomy*, Vol. XVII, No. 7, p. 373. Geneva N. Y., 1925.

BARRON J. H. Utilization of Legumes in Rotation, in the East, *Ibid.*, p. 380.

KENNEY R. In the Middle West, *Ibid.*, p. 389.

OGAARD A. J. In the Northern Great Plains, *Ibid.*, p. 394.

FUNCHESS M. J. In the South. *Ibid.*, p. 398.

BARNES E. E. The Function of Annual Legumes, *Ibid.*, p. 403.

HUGHES H. D. Future of Sweet Clover in the Corn Belt. *Ibid.* p. 409.

FISHER O. S. Relation of Legume Program to other Extension Projects, *Ibid*, p. 418.

CARTER C. E. and SCHOWENGERDT P. F. Campaign, for More Legumes, *Ibid.* p. 431.

The series of articles discusses the importance of leguminous plants in farm economy in its various aspects, special attention being given to

forage plants such as alfalfa, clover, vetch, soybeans, etc. The conditions favourable to each plant, and its particular advantages are described.

The area under leguminous crops in the United States is dealt with by O. S. FISHER, who shows that five States have increased less than 1 %, six have gained up to 10 %, ten from 11 % to 25 %, eight have increased the area from 25 to 50 %, four from 50 to 100 %, and five States show an increase of over 100 %. The reasons, which are many, for this extension of the alfalfa area are discussed by the author.

The further extension of leguminous crops is strongly advocated, and C. E. CARTER and P. F. SCHOWENGERDT outline a scheme which includes advice respecting the growing of different legumes, the main object being the leading and aiding of farmers in the adoption of farm practices that have been proved profitable. W. S. G.

AGRICULTURAL TECHNOLOGY

Utilization of agricultaral produce.

634. **The Power Alcohol Problem.**

HARDY F. *Tropical Agriculture*, Vol. II, No. 9, pp. 192-194. Trinidad, 1925.

The article deals mainly with the various raw materials used, or which might be used, for the production of alcohol, such as sugar, starch, molasses, coal and cellulose substances.

The author considers that sugar and starch are too valuable for the purpose, being foodstuffs ; the supply of molasses would be insufficient, apart from the fact that improved sugar refinery methods are lessening the available quantity of this material. The only suitable raw materials available for large-scale production of power alcohol are coal and cellulose substances.

The cost of production of industrial methyl alcohol from coal has already been reduced to such an extent that it may become a rival of petroleum fuel.

Cellulose substances are available in vast quantities, as waste material from cereal crops, natural vegetation in forests, swamps, etc. This source could theoretically supply alcohol fuel greatly in excess of the present day consumption of petrol. W. S. G.

635. **Preservation of Beets by Desiccation in North Africa.**

MIEGE E. La Conservation des Betteraves par dessication dans l'Afrique du Nord. *Revue Agricole de l'Afrique du Nord*, Year 23, No. 309, pp. 442-444, No. 310, pp. 460-462, No. 311, pp. 479-482. Algiers, 1925.

The cultivation of beets has been tried in Algeria and Tunisia for a number of years, and the results have shown that this crop would give high yields, when well managed. The preservation of fresh beets, how-

ever, which in Europe is a simple matter, is very difficult in a hot climate, as, if left exposed to the air, they putrify rapidly and become useless ; even when placed in a silo they undergo fermentation and the composition is altered and the value diminished.

Storage in the ground presents difficulties and experiments made at Rabat in 1921 showed a fall in saccharose content from August 9 to November 2, from 19.41 % to 7.45 %.

For many reasons, it is desirable to have a process for the preservation of beets which is simple and economical, and desiccation appears to meet these requirements. The method is by no means a novelty and has given excellent results in many countries, but usually requires special installations and the use of combustibles which are often very costly in the Colonies.

Drying in the sun is obviously less costly and more simple and has been tried formerly in California and at Rabat since 1920.

The method followed in Morocco is very simple, the roots being cut into slices which are exposed to the sun, in thin layers. The beets shrivel rapidly, and in three or four days are sufficiently dry to be ensiled or stored in a shed, where they may be kept for several months.

The results of experiments showed that desiccation was practically complete after the third day in the case of thin slices and on the sixth day with hand cut fragments.

The loss in weight of the slices, after the second day was 54 %, and 75 % after the third day. The entire roots take from 8 14 days to dry.

Analysis showed that the moisture content of dried, entire roots fell to 20 % and that of dried slices to 13.15 %, the sugar content increasing from 16-18 % to 55-61, and even to 65.5 %. There is however, a partial transformation of saccharose to reducing sugars.

The sun drying method is of practical value to colonials and even natives, and results in a perfectly preserved product which is appreciated by all farm animals. W. S. G.

636. **Variations in the composition of a sugar beet according to the disintegration of the tissues and the pressure.**

MUNERATI, O. Variations dans la composition du jus d'une betterave suivant l'état de désintégration du tissu et des procédés de pression. *C. R. de l'Académie des Sciences*, vol. 180, No. 15, p. 1176-1178. Paris, 1925.

When a beet is subjected to successive gradually increasing pressures of from 50 to 400 atmospheres, and if the juice corresponding to each pressure is collected, it is observed that the quantity of solid matter in the juice clearly decreases with the increase of pressure.

Different variations are obtained by using different methods of pressure. These facts explain, at least in part, the differences which are sometimes observed between the richness of the pulp in saccharose and that of the juice. In order to make a suitable use of the sensibility of densimeters and to estimate the degree of purity with the maximum precision, it is absolutely necessary to extract the juice from a standardized pulp.

A.F.

637. **The composition of the juice of sugar beet in the season of 1924-1925.**

VONDRAK JIRI. (Forschungs-Institut der csl. Zuckerindustrie). Bericht über die Zusammensetzung der Säfte der Kampagne 1924-25. *Zeit. f. die Zuckerindustrie der cechoslovakischen Republik*, Year XLIX, No. 46-47, p. 355-362, 5 tab. Prague, 1925.

It appears from the writer's researches that the purity of the juices of diffusion and of the syrups was much greater and the quantity of nitrogen smaller than in the previous season. Aided by the favourable composition, the manufacture of sugar was facilitated and only in a few factories was there partial deterioration of the beet caused by the very high temperature which was experienced at the beginning of the season, or by difficulty of extraction through diffusion or through a heavy microbic infection by *Leuconostoc*. In some factories the production of magnesian precipitates during the evaporation of the juice was also noticed.

On the whole it was a favourable year compared with the previous four years. A. F.

638. **The action of lactic fermentation on slices of sugar beet.**

KNOR, Fr. *Erfahrungen mit der Impfung ausgelangter* " Schnitzil " mit " Lactazidin " in der Dobrovicer Zuckerfabrik. *Zeit. f. die Zuckerindustrie der Cechoslovakischen Republik*, Year XLIX, No. 17-18, p. 129-132. Prague, 1925.

The treatment of slices of sugar beet with the bacteria of lactic fermentation does not cause any loss of nutritive matter. They are entirely innocuous to cows feeding on them. The objections raised by some investigators to the watering which the slices are subjected to in consequence of the addition of the culture liquid have no force, all the more so as the increase of water barely amounts to 0.26 % of the weight of the slices themselves A. F.

639. **Rational grinding of maize.**

MAROTTA, D. and DI STEFANO, F. (Chemical Lab. of Public Health). *Ann. di chimica applicata*, v. 15, No. 6, p. 227-238. Rome, 1925.

The easy deterioration of maize meal, due to the high percentage of fat contained in the germ, is known and the great advantages which might be gained by degermination before grinding seem evident. Hygienic advantages, because, the portion rich in fatty matter and a ready harbour for germs being eliminated, a better and better keeping meal would be obtained ; economic advantages, because the products which are thus derived might be better utilized for feeding cattle.

Degermination is however not possible with the stone grinding mills which are generally used by the country people. In it the maize is crushed and ground between two disks of stone one of which is fixed and the other revolving, so that the germ becomes both reduced to powder and mixed with the meal. Moreover, the increase of temperature through grinding

affects the quality of the product by increased acidity; the product is then also rendered inferior by the high content of cellulose and fatty substances in the grain.

High milling, with cylinders, would remedy these drawbacks, but it is seldom used because the large mills are situated far from the centres of production, so that only 10 million quintals out of the 30 millions consumed in Italy are ground in them. A good remedy for this state of things is afforded by the medium grinding mill with cylinders made on the NEGRI patent, which can work with small quantities just as the grindstones do, performs all grinding operations and has the advantage of giving a completely degerminated product.

In it, the maize, from the magnetic apparatus which serves to keep back the pieces of iron which are generally mixed up with the maize, passes to the first rolling mill with coarse grooved cylinders which accomplish the preliminary fracture. It then passes to those with medium grooving, which completely detach the germs, which along with the first flour are eliminated with the first sifting, and then sacked. It then is passed successively through cylinders with finer grooving varying with local custom, and there occurs the successive classification into fine flour and semolina with elimination of the bran elements. From the writers' analyses the superiority of the meal obtained by this method which, in addition to degermination, makes possible a more rational separation of the bran elements, is evident.

The economic advantage is derived from the collection of the germ which can be used for oil and for making cattle cakes.

The installation costs relatively little and its maintenance is easy and cheap. A. F.

640. **The final crushing of the olive pulp by the same machine.**

GIMENEZ, T. *El progreso agricola y pecuario*, a. XXXI, No. 1394, p. 559-361, 1 fig. Madrid, 1925.

With modern machinery and high pressure it is possible to obtain a 7 % increase from the crushing of the olive pulp, but in order to reach this it is necessary to increase the thickness of the net containers so that the larger output does not balance the greater expense of the containers.

Considering that the greatest drawback to the extraction of the oil from the olive is the stone, the previous separation of it solves the problem of the final crushing of the pulp.

With the "Tafur" machine of Spanish construction it is possible to obtain this separation soon after the first crushing of the cold mass of olives. The advantages thus obtained are: decrease in the breakage of the nets as it is not necessary to employ very high pressure in the first crushing of the pulp; first pressing of the pulp up to 4.80 % with hardly any expense in view of the fact that the lever or the beam of the hydraulic press can be used; the oil so obtained is perfectly edible and the colour, odour and taste exactly the same. Fresh pulp must, however, be used.

Continuing the author cites a series of testimonials on the "Tafur"

machine, amongst which is one given by various experts present at the experiments carried out at Villafranca de los Barros (Prov. Badajoz).

Of great importance is the use that can be made of the residue. As no stones remain in the pulp it does not present the drawbacks that up till now have been experienced when using it for feeding live stock. The "*Estación Agronómica Central*" of Madrid states: "This pulp is an excellent food for pigs and in fact for live stock in general, but care must be taken to mix it with other fodder when giving it to other animals".

The author according to a calculation based on practical results, calculates a certain profit of 102 pesetas for each 1000 kg. of pulp so treated when using the "Tafur" machine which works at the rate of 500 kg. of pulp and stone per hour with a motor of 2 HP. E. M. F.

641. The toxicity of cotton seed oil and cottonseed.

SCHWARTZE, E. W. and ALSBERG, C. L. (Bureau of Chemistry, U. S. Department of Agriculture). Relation between Toxicity of Cottonseed and its Gossypol Content. *Journ. of Agricultural Research*, vol. XXVIII, No. 2, p. 173-189, 13 fig., bibl. Washington, S. C., 1924.

Id. Pharmacology of Gossypol. *Ibidem*, p. 191-197, 2 tab., bibl.

The toxicity of cotton seeds is due to their oil content; the different toxicity of seeds coming from various localities is thus explained, inasmuch as the quantities of oil contained in them are different. Confirmation of this assertion is given by the fact that in the States on the Atlantic coast, where the seeds contain about 1 % of oil, their toxic effect is more feared than in the South-West States in which the oil is found in smaller quantities in the seed.

When cottonseed oil is administered to animals in small quantities, so as to avoid any considerable loss of appetite but to cause chronic poisoning, it is seen that paralysis, degeneration of the nerves, dyspnoea, cardiac hypertrophy, oedema of the anogenital region and of the lungs, discharges in the serous cavities occur. With injection, pulmonary oedema and discharges in the cavities, lowering of blood pressure and death by cardiac insufficiency are caused.

Cotton seed oil can therefore produce all the symptoms which are observed in animals poisoned by the seed (diarrhoea, loss of appetite and weight, dyspnoea and paralysis). Such poisonings are therefore attributable to the oil. A. F.

642. The Seeds of *Citrullus Vulgaris* as a Source of Oil.

Bulletin of the Imperial Institute, Vol. XXIII, No. 2, pp. 149-157. London, 1925.

The water-melon (*Citrullus vulgaris*, Schrad.) is now cultivated throughout all warm countries. Seeds of different varieties have been examined at the Imperial Institute as a source of oil.

Four samples of seed from the Gold Coast, called " Neele " or " Niri " seed yielded a yellow oil, the percentage in the seeds as received varying from 33.8 to 44.4. The oil would be classed as a " semi-drying " oil; the residual meal is richer in crude protein (28.2 % to 35.3 %) than undecorticated cotton-seed cake; no cyanogenetic glucosides were found, but there were indications of an alkaloid substance. The seed was valued at £17 to £18 per ton.

Seed received from Sierra Leone gave an oil somewhat greener in colour than that from the Gold Coast, but very similar in character.

Samples of *Citrullus vulgaris* seed from the Kano province of Nigeria were forwarded in September, 1924. The plant, known locally as " Guna ", is grown as a catch-crop on millet farms. The seeds are used both for food and oil extraction. Guna oil is not so sweet as groundnut oil, but is much cheaper.

The seeds contained 6.4 % moisture and 45 % oil. The oil was a pale greenish-yellow liquid, with a slight, pleasant odour. Guna oil, like other varieties of *Citrullus vulgaris*, is a " semi-drying oil " and the constants closely resemble those of cotton-seed oil. The residual meal, after extraction of oil with light petroleum, was odourless and almost tasteless; meal with 7 % fat contained 40 % crude proteins, and was free from alkaloids and cyanogenetic glucosides.

Guna seeds as a source of oi lwould be worth in London about £17 to £18 per ton in consignments of 100 to 200 tons. Guna oil of good quality should realize the current price of crude Egyptian cotton-seed oil (about £47 per ton, January 1925). The residual meal would probably realize in Great Britain rather less than extracted soy bean meal, quoted about £12 per ton. W. S. G.

643. **Bacterial Deterioration of Cotton During Damp Storage.**

BURNS A. C. (Cotton Research Board, Cairo). *Jnl. of Textile Institute*, Vol. XVI, No. 6, pp. 185-196, figs. II, bibliography. Manchester, 1925.

The author's investigations showed that :—

1) Bacterial and fungoid infection, as a source of deterioration of cotton during damp storage, is to be sought for and controlled in the unginned rather than in ginned cotton.

2) Cotton which has been exposed to very damp storage before ginning is much less resistant to bacterial or fungoid attack during subequent storage than is cotton stored under dry conditions.

3) Ventilation of cotton during storage " in seed " represses bacterial and fungoid processes only in cases where the damp material is able to dry rapidly.

4) Sun drying of cotton is advocated in addition to ventilation, particularly before storage " in seed " and prior to baling after ginning. The process of damping cotton before or during baling is not recommended.

W. S. G.

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644. **The Modern Treatment of Flax.**

EYRE J. VARGAS (Director, Linen Industry Research Association). *Jnl. of Textile Institute*, Vol. XVI, No. 8, pp. 250-256. Manchester, 1925.

The special value of the flax fibre lies in the fact that it can be separated in the form of long, fine, strong, strands or groups of fibres, which are much finer than those of hemp or jute ; in comparison with ramie, the individual fibres composing the strands are shorter and finer, and in comparison with cotton, although but very little longer, lack the convolutions, which make the spinning of cotton comparatively easy.

The maximum length of the strand is theoretically determined by the length of the branchless part of the flax stem, but in practice depends largely on the care taken in harvesting and retting, and other operations.

After harvesting, the next important process is that of retting, a bacterial fermentation of pectinous substances which surround the fibre in the plant. The process may be carried out, with or without access of atmospheric oxygen, the former by dew retting, the latter by water retting.

Many modifications of the water retting process have been made, by raising the temperature of the water, the addition of cultures of organisms, etc., but with only partial succsss. The addition of chemicals to the water in which the flax is steeped has been tried, but the resulting fibre has not proved satisfactory to the spinner.

The various methods of retting involve retting the straw and subsequently drying for the next operation ; many attempts have been made to dry retted flax straw by artificial means, but no efficient method has yet been evolved.

Between every stage in the working of flax advantage accrues from giving the fibre a rest.

If uniform crops could be harvested, retting would be more uniform but the wide variations and irregularities in the harvested crop has made machine scutching unsuccessful up to the present, and hand scutched fibre is superior.

The future of the linen trade seems to depend largely upon the production of better quality goods from lower grade materials, a state of affairs which calls for a fuller knowledge of the properties of the raw materials.

W. S. G.

645. **The Value for Paper Making of " Bakaka ".**

DE BALZAC F. H., MAHEU J. and CERCELET, M. *Bulletin de l'Agence Générale des Colonies*, Year 18, No. 204, pp. 360-372, plates 2. Paris, 1925.

Samples of the stems of the " Bakaka " plant, a species of sorghum (*Sorghum vulgare* Pers.), were received from Madagascar for investigation as to suitability for paper making.

The authors give details respecting the botanical and chemical constitution of the plant, and also of the preparation of paper from the material.

The investigation showed that the stem of the bakaka plant is rich in cellulose, and after treatment yields 37 %, which compares favourably with the cellulose yield of many other plants. The content of woody matter and ash is low, and both are easily eliminated.

The material is easily bleached, gives a good yield and furnishes a paper of good quality. W. S. G.

646. **Preservation of Perishable Fruits and Vegetables.**

OVERHOLSER Prof. E. L. (University of California). *Refrigerating World*, Vol. 60, No. 7, pp. 25-26. New York, 1925.

It is well-known that fruits such as figs, apricots and peaches cannot be kept long in the fresh condition at cold storage temperatures of 32° F. to 35° F.

The author carried out investigations from which the following conclusions were drawn: —

Strawberries, raspberries, loganberries, blackberries, cherries, figs, apricots, peaches, currants and gooseberries, frozen at 10°-12° F., in water or sugar solution, or crushed with or without sugar, in closed containers, were kept for a year without deterioration of colour or flavour.

Freezing with dry sugar, kept quickly perishable fruits for use in pastries, ice cream, jams etc.

Fruits frozen in 30-40 % sugar solution were as excellent as fresh fruit.

Shelled fresh peas and asparagus have been frozen in water and subsequently cooked and have retained the flavour of the fresh material. W. S. G.

647. **The causes which determine the cooking capacity of vegetables.**

D'IPPOLITO, G. (R. Agricultural Station of Modena). *Le Stazioni sperimentali agrarie italiane*, vol. LVIII, parts. 1-6, p. 128-145, bibl. Modena, 1925.

The phenomenon of the cooking capacity of vegetables has been attributed solely to the degree of hardness of the water. On the other hand, it is well known that vegetables which are easily cooked are grown on certain soils rather than on others and it is considered by some people that calcareous soils produce hard vegetables, an assertion which is disproved by the facts, inasmuch as the coastal regions of the Lower Adriatic with particularly calcareous soil produce very good kinds of vegetables, noted for easy cooking.

Now it is a fact that all varieties of vegetables are cooked more or less satisfactorily in distilled water. There are however vegetables capable of being well cooked in hard water and it is only to these that the qualification *easily cooked* will be applied.

This quality is in relation to the histological constitution of the amyliferous tissues. When in the membrane the pectic compounds prevail and are in a soluble state, or in a condition to be hydrolized, the tissue

then is easily decomposed, acquiring a special softness by reason of which the vegetables can be cooked in all waters.

When, on the other hand, cellulose, and hemicellulose and the pectic compounds are not in a condition to be hydrolized, the amyliferous tissue then preserves its original rigidity increased by the smaller dimensions of the elements, and the vegetables do not cook well.

The action of bicarbonate of soda, used in the kitchen for cooking vegetables, might be explained by admitting that, by its solvent action on pectoses, it causes the breaking down of the amyliferous tissue and consequently the pulpy condition of the mass. But since it does not modify the rigidity of the cell walls, it only produces a partial cooking very different from natural cooking.

In old vegetables, we get equal power of absorbing water and swelling of the starch, but the membrane of the amyliferous cells is no longer in a condition to undergo those changes of which it was capable when young; hence the resistance of old vegetables to cooking. During cooking the amyliferous cells remain intact. A. F.

648. **Cold Storage of Oranges.**

HARRISON J. E. *Journal of Department of Agriculture of Victoria*, Vol. XXIII, Part 7, pp. 428-432, tables 7. Melbourne, 1925.

Experiments on the cool storage of Washington Navel oranges were carried out to ascertain the conditions which retard or develop the growth or mould in storage.

The value of sweating was studied; the process being carried out at a temperature of 70° F., until the skin of the fruit was soft and pliable. Wrapping the finit in paper had little influence on mould development.

As a result of the experiments it was found that :—

(*a*) The process of sweating offers the best means of guarding against the outbreak of mould in cool storage.

(*b*) An average temperature of 32°F, is unsuitable, owing to the danger of freezing.

(*c*) The average temperature of 34°F. will avoid the danger of freezing and gives less mould than higher temperatures, and is recommended.

(*d*) The fruit from different districts varies in keeping quality.

W. S. G.

649. **Quantitative determination of lactic acid.**

LEONE, P. and TAFURI, G. B. (Istituto chimico della R. Università di Roma). Sulla determinazione dell'acetaldeide nella determinazione quantitativa dell'acido lattico. *Annali di chimica applicata*, v. 15, No. 5, p. 206-208. Rome, 1925.

To avoid the drawbacks experienced with various methods of determination of lactic acid, especially in muscles and in cheeses, the writers suggest the following method, based on the determination of acetaldehyde.

The solution containing lactic acid is placed in a KJELDAHL apparatus with 50-100 ccs. of H_2SO_4 at a 50 % strength and is distilled for an

hour keeping the temperature between 140°-150° and collecting the distillate in a solution of hydroxylamine of standard strength (N/10 or N/100 according to the degree of precision required and the quantity of lactic acid present) in which hydroxylamine has been set free, with previous addition of NaOH solution strong enough to render the solution exactly neutral using Phenolphthalein as indicator.

During the operation a slight current of air is made to pass into the apparatus which removes the aldehyde as it is formed. An oxime is thus obtained. The excess of hydroxylamine is then measured with a solution of H_2SO_4 of strength corresponding to that of the previous solutions, using methyl-orange as indicator. The difference between the hydroxylamine introduced and determined by a decoloration test and that given, represents the hydroxylamine combined with the aldehyde and hence corresponding to the lactic acid. The process is based on the fact that phenolphthalein is not sensitive to hydroxylamine, while methyl-orange is very sensitive to it. The decoloration test of the hydrochlorate solution of hydroxylamine is effected by exactly neutralizing 25 cubic cm. with the standard solution of NaOH, using phenolphthalein as indicator, and afterwards adding a few drops of methyl-orange; the hydroxylamine which has been set free by the NaOH is measured with H_2SO_4.

A. F.

PLANT PROTECTION

Plant Parasites.

650. Plant Diseases and Pests in the Argentine Republic during 1918-1923.

GIROLA, C. D. and ARAUJO, J. J. Enfermedades de las Plantas. Lista de las observadas en la República Argentina en los años de 1918 a 1923. Publicación del Museo agrícola S. R. A., No. 46, pp. 46. Buenos Aires, Imprenta "Gadola", 1925.

Enumeration of plant diseases and pests observed by the authors in the Argentine Republic from 1918 to 1923.

Seven bacteria and sixty-seven fungi appear in the list as agents of disease; there are also included one parasitic Phanerogam and forty-one Nematodes, spiders, and especially insects.

The diagnostic characters of the diseases caused by bacteria and fungi are summarised; the common local names of these and of the parasitic animals are mentioned together with indications of the respective means of control.

There follows an alphabetical list of the sixty-one plants attacked, the scientific and common names of which are given. G. T.

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651. ***Phyllosticta Pollaccii* n. sp., Deuteromycete parasitic on *Acacia Baileyana*, in Italy.**

AGOSTINI. Una nuova malattia dell'Acacia Baileyana F. Muell. (Phyllosticta Pollaccii n. sp.) *Rivista di Patologia vegetale,* Year XV, No. 5-6, p. 113-122, 4 fig. Pavia 1925.

During May 1925, on some specimens of *Acacia Baileyana* growing in the Botanical Garden of Siena, which had been grafted in 1923 on *A. floribunda,* it was noticed that the leaflets, specially those belonging to adult leaves, were spotted in a characteristic manner on both sides. The spots were formed of three successive differently coloured zones, from about the centre of the limb towards their apex : next to a first yellowish zone came a brown zone succeeded by an ash-grey zone. On this last, occupying the apical portion of the leaflet, there developed, like little black sparse points, the epiphyllous picnidia of a sphaeroidea regarded by the author as the cause of the injury and described as a species new to science under the name of *Phyllosticta Pollaccii.*

The attacked leaflets finally fall to the ground, when it is desirable to remove and destroy them. Sprayings with Bordeaux mixture, before the flowering season will serve to prevent the attack of the Deuteromycete.

The description of the new *Phyllosticta* is preceded by some notes regarding the importance of the growth of various species of *Acacia* and by a list including one Myxomycete and eighty-two Fungi already observd on this same plant. G. T.

652. ***Cudoniopsis pusilla* n. gen. and n. sp., Ascomycete parasitic on the *Myrtacacea Eugenia proba*, in Argentina.**

SPEGAZZINI, C. Un nuevo género de las Helvellaceas. *Mycologia,* vol. XVII No. 5, pp. 210-212, 7 fig. Lancaster Pa., 1925.

Description of a Discomycete of the fam. *Helvellaceae* which the writer considers as representing a genus (*Cudoniopsis*) and a species (*Cud. pusilla*) new to science.

The fungus in question was observed behaving as a parasite on live branches, two or three years old, of the *Myrtacacea Eugenia proba* Berg. in Argentina, and, to be exact, in the neighbourhood of Puerto Blest (Neuquen). C. T.

Insect Pests.

653. ***Binema-binema* n. gen. et n. sp., and *B. arnata* n. sp., Nematodes parasitic on the Arthopteron *Grillo-talpa* (Neocurtilla) *hexadactyla* in Brazil.**

TRAVASSOS, L. Quelques Nématodes du *Gryllotalpa. Comptes rendus des séances de la Société de Biologie et de ses filiales,* Vol. XCIII, No. 21, pp. 140-141, 7 fig. Paris, 1925.

In the province of Angra dos Reis (State of Rio de Janeiro), the author found three Nematodes parasitic on *Gryllotalpa* (*Neocurtilla*) *hexadactyla*

Pty. of which he describes the first two, observed in the posterior intestine of the Orthopteron ; the author has instituted the new genus *Binema* for them, naming the type species *B. binema* and the other *B. ornata*.

Both these species have the peculiarity of laying two eggs, rarely three, enclosed in capsules similar to those of some Cestodes. G. T.

654. **Hymenoptera Parasites of *Coelaenomenodera elaeidis Coleoptera*, injurious to the Oil Palm on the Gold Coast.**

WATERSTON J. On some Eulophid Parasites (*Hym. Chalcidoides*) of the Oil Palm Hispid Beetle. *Bulletin of Entomological Research*, Vol XV, part 4 385-395, figs. 6. London, 1925.

The oil palm (*Elaeis guineensis*) is periodically subjected, in West Africa, to the attacks of *Coelaenomenodera elaeidis* Maul., a Coleopteron of the *Hispidae* fam., which bores galleries in the leaves of its host.

G. S. COTTERELL, Assistant Entomologist on the Gold Coast, has obtained by breeding, from the first stages of development of *C. elaedis*, collected at Aburi in 1923, some Hymenoptera (*Eulophidae* fam.), parasites of such Coleoptera, new to science, of which the author now gives the detailed description :

(1) *Dimmockia aburiana* n. sp. bred from *C. elaeidis* ;

(2) *Cotterellia podagrica* n. gen. and n. sp. The females of *C. podagrica* issued from the pupa of the Coleopteron and once from its larva, while the males were always obtained from *C. elaeidis* larvae ;

(3) *Closterocerus africanus* n. sp., obtained by breeding from *C. elaeidis* eggs ;

(4) *Achrysocharis leptocerus* n. sp., bred, like the preceding, from *C. elaeidis* eggs. G. T.

655. **Coleopterae predatory on *Parlatorea blanchardi*, a Coccid injurious to the Date Palm in Algeria.**

BALACHOWSKY, A. Note sur deux prédateurs du *Parlatorea blanchardi* Targ. et sur leur utilisation en vue de la lutte contre ce Coccide. *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord*. Vol. XVI, No. 6, pp. 167-172, tab., 1 map. Algiers, 1925.

Parlatorea blanchardi (Targ) Leon, known for a long time in the South of Algeria, appeared suddenly during 1920 in the Colomb-Béchar palm groves where it multiplied so rapidly that shortly after not only was the date crop much reduced, but the palms themselves were threatened with death. On the other hand in Oued Rhir and Mzab, where probably the Coccid has always existed, its damage was insignificant This has led to the supposition that in these latter localities there existed natural enemies of the parasite. The author visited in March and May 1925, the district of Biskra-Touggourt, and discovered south of Constantine two Coleopterae, *Cybocephalus seminulum* Bandi (fam. Nitidulidi) and *Pharoseyammus anchorago* Fairm (fam. Coccinellidae), active predatory beetles — the former

in the adult and larval state, the latter only in the larval state — of *Parl. blanchardi*. Together with the two Coleopterae mentioned lives also *Cyb. flavipes* Reitt. *Pharosoyamus anchorago* has also been found in the south of Tunisia.

Cyb. seminulum exists in Oued Rhir, Mzab, Ouargla and El Goléa.

The distribution of *Parl. blanchardi* in the south territory may be subdivided into three zones: —

(1) Zone of old invasion, where the coccid has always existed and where its damage is restrained by predatory agents: — district of Oued Rhir, Djerid, the oases of Mzab, Ouargla and El Goléa.

(2) Zone of recent invasion, where the Coccid has been introduced without its predatory agents and the damage which it causes there is considerable: — Colomb-Béchar, Touat-Inzegair, Gourara (Adjedir-Chergui and Fatia).

(3) Neutral zone, where the Coccid has not yet appeared, comprising principally the oases of Tidikelt (In Salah) and all the Moroccan palm groves.

Individuals of the predatory beetles mentioned, despatched on the 20th May by rail from El Arfiane to Colomb-Déchar, for acclimatisation, arrived dead after five days, since the predatory beetles themselves, even when provided with abundant food, do not survive more than two days of activity.

The only way of getting over this obstacle would be to obtain the insects as near as possible to the place where they are to be disseminated and not to keep them captive for longer than twenty four hours as a maximum; this might be done if the predatory insects were taken at El Goléa and sent by aeroplane to Colomb-Béchar. G. T.

656. **Hymenopterae parasitic on the "Grape Moth" (*Polychrosis botrana*), in Algeria.**

DELASSUS. Contribution à l'étude de l'Eudemis en Algérie. *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord*, Vol. XVI, No. 6, p. 166. Algiers, 1925.

For two or three years the damage caused by the "grape moth" (*Polychrosis botrana*) in Algeria has increased in intensity. Such damage was considerable during 1924 in the Mitidja plain and in Algerian Sahel, more especially in the districts of Rouiba, Maison-Blanche, Maison-Carrée, Boufarik, Douéra, Draria, etc.

Insecticide sprays have not up to the present given decisive results.

In March 1925, the author found in large numbers, especially at Maison-Carrée and Maison-Blanche, three Hymenopterae which he considers may effectively help the vine growers in controlling the Microlepidoptera. These parasites of *Pol. botrana* are the Calcidids *Dibrachya boucheamus* Ratz. and *D. affinis* Masi, and the Ichneumon *Hemiteles areator* Grav.

The first two appear to be much more common than the last.

G. T.

657. **Varieties of sweet potato resistant to root Nematodes *(Heterodora radicicola)*, in California.**

WEIMER, J. L. and HARTER, L. L. Varietal Resistance of Sweet Potatoes to Nematodes, *Heterodora radicicola* (Greaf.) Müller, in California. *Phytopathology*, v. 15, No. 7, pp. 423-426. Lancaster, Pa., 1925.

Observations made during the spring of 1923 show that *Heterodora radicicola* was fairly common in the district of Los Angeles and other places in California where the Nematode — easily propagated by tubers of infected seed — had caused previously and still causes more or less serious damage to the sweet potato crop.

The discovery made in one of the fields examined that *H. radicicola* attacked certain varieties of sweet potato much more seriously than others, led to the consideration of the possibility of controlling the Nematode by means of the use of resistant varieties.

Cultivation tests were therefore carried out, in 1924, at Garden Grove, Baldwin Park and Santa Ana making use of eight varieties (" Red Brazil ", " Red Jersey ", " Southern Queen ", " Big stem Jersey ", " Yellow Belmont ", " Nancy Hall ", " Porto Rico " and " Little stem Jersey ") the tubers of which, previously disinfected with corrosive sublimate at a strength of 1 % for 10 minutes, were then planted in ground known to be strongly infected by *H. radicicola*.

It was thus ascertained that the varieties " Red Jersey ", Little Stem Jersey ", " Big Stem Jersey ", " Porto Rico ", " Southern Queen " and " Yellow Belmont ", if not entirely immune, are highly resistant and may take the place of more susceptible varieties on land infested by the nematode. The more resistant varieties of sweet potato can also be used instead of other more susceptible crops on sandy soil infested with *H. radicicola*. G. T.

658. **Diptera belonging to the genus *Atherigona* injurious to various plants, in India.**

MALLOCH, J. R. Some Indian Species of the Dipterous Genus *Atherigona* Rondani. *Memoirs of the Department of Agriculture in India*, Entomological Series, vol. VIII. No. 11, pp. 111-125, 3 Tab. Calcutta, 1925.

Until recent times the species of the genus *Atherigona* Rondani were considered innocuous, since the larvae of these Diptera, which were known, only fed on decomposing vegetable matter.

Researches of entomologists of the Department of Agriculture at Coimbatore having, however, shown that many larvae of Atherigona, existing in India, are injurious to cereals and other plants, the writer with the object of facilitating inquiries regarding these insects undertook the identification of the adults, which are very similar to each other. Some of the descriptions in the present paper were previously published elsewhere: they have been reproduced here for the convenience of students. As an appendix is reproduced a short note by Y. RAMACHANDRA RAO, who deals with the habits, the geographical distribution (in India) and the plants

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on which the Indian species of *Atherigona* described by MALLOCH feed.

Among these species may specially be mentioned :—

1) *Ather. destructor* reared from *Panicum miliaceum, P. miliare, P. frumentaceum* and *Setaria italica* ;

2) *Ather. nudiseta*. reared from *P. stagninum, P. frumentaceum* and *P. colonum* ;

3) *Ather. indica*, reared from *Andropogon Sorghum* ;

4) *Ather. pallidipes*, reared from a cocoon of *Oryctes* ;

5) *Ather. pallidipalpis*, reared from seed potatoes. ;

6) *Ather. atripalpis* n. sp. reared from *Setaria italica* var. " Sadaitenai " and from *Panicum plicatum* ;

7) *Ather. oryzae* n. sp., reared from rice, from wheat and from *Rottboellia compressa* ;

8) *Ather. eriochloae* n. sp., reared from *Eriochloa polystachya* ;

9) *Ather. miliaceae* n. sp., reared from *Panicum miliaceum* ;

10) *Ather. approximata* n. sp., reared from *Pennisetum typhoideum* ;

11) *Ather. bituberculata* n. sp., reared from *Paspalum scrobiculatum*.

G. T.

659. ***Scutigerella immaculata*, Myriopod injurious to Crops in France.**

FEYTAUD, J. Sur les ravages causés par un Symphyle (*Scutigerella immaculata* Newport). *Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol. XI, No. 26, pp. 725-726. Paris, 1925.

The swarming and harmfulness of *Scutigerella immaculata* Newp. in crops in France is mentioned, apparently for the first time. The author noticed that in the southern portion of the Landes, during 1925, this myriopod causes injury particularly to the root system of maize, the cultivation of which in certain places is made impossible. Farmers of this area for some years past attribute the damage noted in their crops of maize, beans, beet, etc. to the presence of some root-eating Aphids and *Scut. immaculata*, previously recognised as injurious in the island of Guernsey and in the United States of America. G. T.

660. ***Ortheziopa reyinei* n. g. and n. sp. and *Rhizoecus coffeae*, n. sp., a Coccid Injurious to Coffee, in Dutch Guiana.**

LAING F. Description of two species of Coccidae feeding on roots of Coffee *Bulletin of Entomological Research*, Vol. XV, part. 4, pp. 383-384, 2 figs. London, 1925.

In Dutch Guiana two coccidae which live on coffee roots have been collected.

The author has recognised the first as being a representative of a genus and a species new to science, which he here describes respectively under the names of *Ortheziopa* and *O. reynei*.

The second coccid, found at Paramaribo, is styled by the author *Rhizoecus coffeae* n. sp. G. T.

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FOREWORD

The index arranged alphabetically is divided into five sections: (1) original articles; (2) proceedings: of the International Society of Soil Science; of the International Commission for the Study of Chemical Fertilizers; of the International Seed Testing Association; of the International Association of Poultry Instructors and Investigators; (3) special activities of the Bureau of Agricultural Science of the International Institute of Agriculture; (4) agricultural intelligence; (5) plant diseases and pests.

These two last sections are divided into two parts: *a*) subject matter; *b*) authors; they contain both the references of the first three sections and of the current notices.

Under generic headings only information of a general character is given; information on special subjects is given under that special heading.

The four first sections have been compiled by Dr. Francesca Dorio, those on plant diseases and pests by Prof. Giulio Trinchieri.

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